# ELECTRONICS Australia

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HiFi, Radio & Computers

JULY 1979

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FEATURE STORY: AUSTRALIA'S FILM & TV SCHOOL

## SPECIAL SECTION FOR THE NEWCOMER TO ELECTRONICS!

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In any range of equipment there is a leader. One which sets the standard by which the others are measured.

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# ELECTRONICS Australia

VOL. 41 No. 4

JULY, 1979

Australia's largest selling electronics & hi-fi magazine

## New hifi disc

*Don't miss our story on the fantastic new audio disc system developed by Philips. Described as "the disc of the future", it uses laser pickup for super-hifi sound.*

**STARTING THIS MONTH!**

**DREAM 6800:** connect your new hobby computer to a TV set for UFO intercept, block puzzle, tank battle, secret number, and more. Details on p84.

## On the cover

*Students of the Australian Film and Television School (Sydney) are given thorough practical training in all phases of film and TV production. Because of this, graduates from the school are being eagerly snapped up by the industry. See our feature story starting on p12. Pictures courtesy AFTS.*

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# Signetics Op Amps: Fast Performers.

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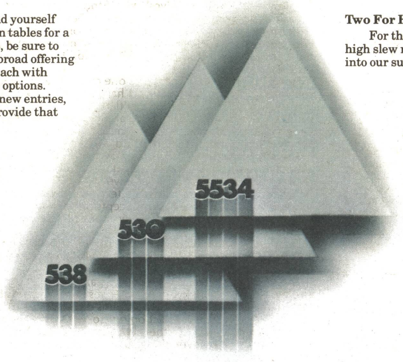
## Choose from three new op amps with high slew rates. One specifies the industry's lowest noise: 4nV/√Hz!

The next time you find yourself searching the specification tables for a high-performance op amp, be sure to search ours. You'll find a broad offering — more than 60 models, each with package and temperature options. You'll also discover three new entries, one of which is likely to provide that exceptional spec you need.

**Our Quiet Performer: SE/NE5534.**

If low noise is critical to your design, then you need our new SE/NE5534. There's not another op amp around with better noise performance. With input noise specified at 4nV√Hz at 1 kHz, this device can drive a 600-ohm load. Great for quality audio equipment and instrumentation/control circuits. Our quiet performer also offers a generous 10 MHz bandwidth and a respectable 13V/μsec slew rate.

When you compare the SE/NE5534 with standards like the μA741 and LM307, you'll find that it offers superior performance — spec for spec. This outstanding op amp is internally compensated for gains equal to, or greater than, 3. And if you want to optimize frequency response for unity gains, capacitive load, low overshoot, etc., you can do so easily with an external capacitor.



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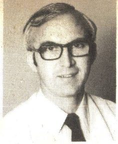

# Editorial Viewpoint

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## A better deal for the newcomer

A few weeks ago I received one of those letters which all magazine editors get occasionally, from an anonymous critic. Generally I don't respond to anonymous criticism, because it seems to me that anyone who believes in the validity of their criticism will be prepared to identify themselves. Perhaps it is symptomatic that most anonymous letters tend to be emotional rather than logical, and this one was no exception.

However in this case there was one criticism in the letter which I just can't resist replying to — not just because I happen to disagree with it, but because it is so grossly invalid. This was the claim that Greg Swain's recently begun Practical Electronics series of articles is "nauseating", and unworthy of either the magazine or Greg's science degree background. According to our anonymous critic, "the average high school student could do better".

The implications of this criticism are twofold: First, there is the implication that almost anyone can write this sort of basic tuitional material, designed to help the reader who is just starting an involvement with electronics. In fact, nothing could be further from the truth. As any technical writer or teacher will tell you, it is far more difficult to convey basic concepts and information to someone with a limited background, than it is to convey more complex concepts to people who are further advanced.

I can assure you that writing any kind of technical explanatory material is not as easy as it looks. Merely having the knowledge isn't enough — you have to be able to pass it on.

The second implication is that a magazine like EA should not be devoting space to elementary material of this type, but should be publishing more advanced-level material instead. Again I believe this is quite wrong. At a time when electronics is making a tremendous impact on our society by means of computers, automation, satellites and all sorts of other developments, it seems to me that a magazine like EA should be doing everything it can to help people understand what is going on. An important part of this is surely to provide basic introductory material for beginners and students.

That is certainly the way we see it here at EA. In fact, we are so convinced of the need to provide plenty of introductory material that starting this month we are actually going further, and boosting our existing editorial content in this area. From now on, you will find a specific "newcomer" section in each issue, with a number of articles specially chosen for those just breaking into the subject.

I should perhaps note, for the benefit of other readers, that the addition of this section is not at the expense of other areas. You'll find that nothing else is being sacrificed; all of our regular features are being continued.

It's all part of our continuing effort to make the magazine of greater interest and value.

***— Jamieson Rowe***

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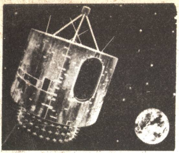
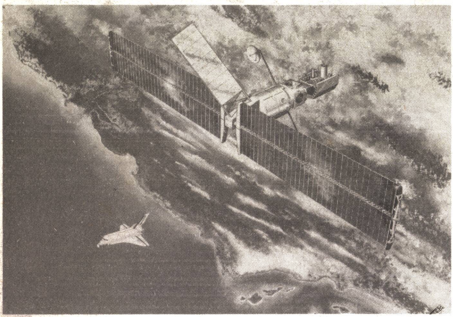


# News Highlights

## 25kW power module may extend Shuttle missions



*This is an artist's concept of a 25kW power module that may be among the first long-life devices to generate large amounts of solar power in space. Under contract to NASA's Marshall Space Flight Center in Huntsville, Alabama, Lockheed Missiles & Space Company, Sunnyvale, California, conducted a study to assess the feasibility of using existing hardware in the module's development, to project future payload requirements and to identify ways to increase power output from 25kW to as much as 250kW. The instrument would support shuttle and spacelab operations for at least five years before being returned to earth for refurbishment and relaunch.*

## Computer with a human voice

Britain's Marconi space and defence systems company has developed a new automatic broadcast system which allows a computer to put together human speech. The system has been adopted by the UK Civil Aviation Authority and will be used to transmit in-flight weather reports from the summer of next year.

Marconi says it has recorded the voice of one of its executives, Colonel John West, reading a range of standard weather report phrases, words and figures. These are converted into digital form and stored in a computer bank.

When the computer is fed the latest telex report it automatically produces and arranges the sequence of words, phrases and figures needed to create a human voice report.

## Programmables excite pacer firms

Large-scale integration and other state-of-the-art electronic technologies have spawned a whole new generation of cardiac pacemakers. The latest models in the US come with a variety of programmable functions that allow doctors to tailor the devices to individual patient needs.

Among the reasons for making pacemakers programmable is the need to adjust to recent improvements in operating life. Because units now last five years or more, the change in a patient's condition likely to occur in that time calls for the pacemaker to be adjustable to coincide with his or her needs.

About 10 firms in the US now market pacemakers than can be programmed for a variety of pulse widths and repetition rates. Some even sense and respond automatically to heart malfunctions. What's more, reducing pulse parameters to the exact level needed by the patient has doubled the estimated lifetime of some pacers — to 10 years or more.

To reprogram a device after implantation, a physician would enter the new pulse rate or width using an external controller. This transmits the new information to the pacer in digital form modulated on an RF carrier. A receiver located inside the pacemaker picks up and decodes the signal, and changes the pacemaker's output pulses accordingly.

One pacemaker, made by ARCO Medical Products, Passadena, features no less than 448 programming possibilities!

## New electronics store in Brisbane

Gary Worth, formally of Techniparts in Brisbane, has started a new business trading as Zero One Electronics, 200 Moggill Rd, Taringa, Brisbane.

Zero One will be handling a wide range of products from such companies as: Bishop Graphics, Zilog Components, Honeywell, Fairchild, National Semiconductor, and other major component suppliers. The store will also be marketing the Z80 S100 computer system and associated peripherals.

# Satellite detects oil slicks

A technique has been developed at Lancaster University in Britain for transforming infrared pictures obtained from space satellites into colour maps that may be used to identify, measure and follow the movement of oil slicks at sea.

Oil slicks on water raise the temperature in the affected area by about one degree centigrade and this small increase can be detected by the sensitive infrared measuring devices on board the orbiting satellites. The temperature differences registered by the instruments are normally transformed on the ground into maps with shades of grey representing different temperatures.

The system devised at the University transforms these shades of grey into eight "false" colours. The operator then scans the infrared satellite picture, enlarges a given area, and any one degree rise in temperature will show up as an outstanding colour difference.

The University is searching for known oil slicks to see how effective their technique is in practice. It is also using a land based rig in which sensors pick up infrared radiation from two tanks — one containing water and the other water and oil.

In addition to watching oil slicks the technique can also be used to map land uses, detect forest fires and measure the warm water effluent from power stations.

# A language translator that speaks!

It had to happen — hard on the heels of the Lexicon LK-3000 and Craig M100 language translators, Texas Instruments Incorporated has announced a model that not only displays foreign words, but also uses electronic voice synthesis to pronounce them.

In the past, such calculator-like machines, on the market for about six months now and selling for around $250, have been capable only of displaying words, leaving the equally crucial business of pronouncing them to the tourist. TI's new speaking machine is expected to cost about $50 more than the silent translators, while the tiny plug-in modules in which words and phrases are stored will retail for around $50 each.

Little else is known about the new TI language translator at this stage. Presumably, though, it uses the same electronic voice synthesis technology as the recently released "Speak & Spell" spelling aid.

# High-speed switching devices from IBM

New circuits under development by IBM at its Yorktown Heights research and development laboratories can switch a signal in the time taken by a beam of light to travel no more than 1mm.

This disclosure underlines IBM's commitment to Josephson device development. Apparently, the need to provide liquid helium cooling for computers that would be based on Josephson logic does not daunt the company.

Operating speed of the new circuits is measured in picoseconds. They switch in 7 picoseconds with 6 picoseconds required for the pulse to travel from one circuit to the next.

They are some three times faster than previously tested Josephson devices and 10 or more times faster than the fastest transistor logic circuits.

Calculating logic in the machine currently considered to be the world's most powerful, the Cray, is cooled by freon. It is a matter for conjecture how long it will take for IBM to regain the lead in this area of computer technology with a "superpower" machine based on Josephson devices.

# Cutting vehicle noise pollution

A heavy goods vehicle that makes no more noise than the average family saloon car — this is the result of work carried out by Britain's Transport and Road Research Laboratory (TRRL) using a 38 tonne Foden lorry powered by a Rolls-Royce diesel engine.

Main contributions to the noise reducing program are a new cooling fan, a re-designed exhaust and a reduction in the "rattle" associated with major mechanical components, particularly the crankcase. This has resulted in an external noise level of 81 decibels at 7.5 metres during acceleration from a standing start — believed to be the lowest noise level for any heavy goods vehicle of this weight and power.

# KEYBOARDS

**Microcomputer-based Intelligent Keyboard 103SD24-2**

- Solid state Hall Effect keys with single chip microcomputer.
- 8-bit CPU, ROM, RAM, I/O and time/event counter with 8-bit USASCII coding in 4 modes.
- Serial & Parallel data outputs.
- 14 relegendable keytops for customer assignment.
- 8 deep FIFO character storage.
- N-key rollover.
- Timed auto repeat for designated keys.
- Repeat key controls repeat for other designated keys.
- Secretary shift and audio feedback drive.
- Pin for pin compatible EPROM capability.
- Single 5V supply.

**MOS Encoded Communication Keyboard 53SD5-2**

- Hall Effect solid state keys coupled to MOS encoding.
- Familiar Model 33 array.
- USASCII code assignment with 4 modes of operation.
- Two key rollover.
- Quiet operation — only moving part is key plunger.

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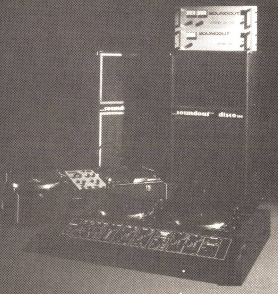

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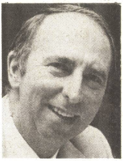
# Computers in Australia — a 100-page report

A 100-page report entitled "Computers in Australia — Usage and Effects" has been released by the Foundation of Australian Resources (FAR). FAR is a non-profit foundation which undertakes selected research projects concerning Australia's natural, physical and human resources.

The report, said to provide the first hard data analysis of computer installations and usage in Australia, was compiled by FAR councillor Dr B. Thornton and Mr P. Stanley, both of the NSW Institute of Technology. Included are contributions from some fourteen Australian, US and UK specialists, and comments from US management authorities at MIT Sloan Business School and Harvard.

Among other things, the report includes:

- Selected topical case studies on computers in the banking, newspaper and telecommunications industries;
- An interpretation of world trends in computerisation;
- A section covering all types of digital computers, plus a special section dealing with microprocessors in the UK.



*Dr B. Thornton*

Copies of the report are available at $25 each (post paid) from Dr B. Thornton, Foundation for Australian Resources, c/- Faculty of Mathematical and Computing Sciences, The NSW Institute of Technology, PO Box 123, Broadway, NSW 2007.

# Rank introduces high-contrast TV tube

Signalling its determination to remain No. 1 in the Australian colour TV market, Rank Arena is progressively introducing a new high-contrast ratio picture tube to its range of colour receivers. The receivers are manufactured by Rank-NEC at Penrith, NSW.

The new high-contrast tube retains the "Black Matrix" system, but improves on it by using pigment filters in the red and blue phosphors to absorb incident light. This has the effect of substantially reducing reflections of ambient light from all sources: daylight, fluorescent lamps and incandescent lamps.

Rank calls its new tube the "Phosphor Plus" tube, and has subjected it to an intensive advertising campaign during recent weeks. Compared with a conventional tube, the Phosphor Plus tube is said to offer a 24% increase in contrast, a 37% increase in colour range, and a 4% increase in brightness.

Rank Industries says that national sales of colour TV receivers are still running at an annual rate of around 450,000 to 500,000 sets (total all manufacturers). Market saturation is now about 75%, and is expected to move steadily towards 90% saturation by the mid-1980s.

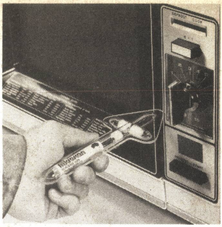
# Business Briefs:

## Loss-maker sold in Kemtron restructure

**Troubled Kemtron Ltd has sold for an undisclosed amount the Weston Electronics division of its loss-making Natronics subsidiary group. The move closely follows the closure by Natronics of its metal glaze resistor factory at Kingsgrove, NSW. Purchaser of Weston is Procom Electronics Pty Ltd, a Melbourne based supplier of communications equipment and systems.**

## R. H. Cunningham to concentrate on audio market

**R. H. Cunningham Pty Ltd has decided to concentrate all its efforts in the professional audio market. This follows the enormous success of the Sennheiser product range which covers dynamic headphones and microphones, RF radio microphones, infrared cordless headphones and test equipment. Rifa Pty Ltd will handle the component division originally handled by R. H. Cunningham.**



# Low cost microwave leakage detector

The latest firm to commence production of Microscan, a low cost microwave leakage detector developed by the CSIRO, is Chuff Lloyd Pty Ltd, Meadowbank, NSW. This product has been an Australian success story, with sales to the UK, USA and Scandinavia.

Microscan contains a light emitting diode that glows red whenever it encounters microwave radiation that exceeds the recommended safety level. The device contains no batteries, has no moving parts, and is particularly useful for checking microwave oven seals, microwave diathermy equipment, and microwave heaters operating at 2450MHz.

Chuff Lloyd Pty Ltd is selling the devices through mail order for $16.50 each (includes sales tax, packaging and postage). The address to write to is: Microscan, PO Box 272, West Ryde, NSW 2114.

# Education exhibition and conference

Educare '79, the fifth Australasian International Education Exhibition and Conference, will be held at the MLC Centre, Sydney, from 17th July to 20th July, 1979.

More than 150 companies will be represented at the exhibition, and will display equipment worth over $4 million. Included will be demonstrations of new technological tools, new teaching methods, and the latest in software and hardware for audio-visual aids.

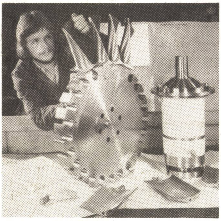
Mr A.L. Knight, Chairman of Educare, said that education in Australian is an industry that exceeds $5000 million per year. The market covers 10,000 teaching institutions, 218,600 teachers, and 4 million students. And re-education and industrial training affects thousands more in the armed forces and all facets of commercial enterprise.

Enquiries to Educare Exhibitions Pty Ltd, 8 McIntosh St, Chatswood, NSW 2067.

# Alternative energy research . . .

## Power from the waves

Britain, among the leading nations in wave energy research, is to provide a generator powered by the waves for an international research program. Here a technician at Centrax Ltd, in the west of England, sets up the blades of the air turbine for the special generator unit now nearing completion.



The generator is claimed to be the first of its kind and will be used in research into wave energy under the auspices of the International Energy Agency. It will provide valuable information about one of the most promising wave energy conversion devices, the oscillating water column (OWC).

In this, the wave motion is used to alternately compress and decompress air in a large air chamber. A valve system in the walls of the chamber directs this air flow through the turbine which, in turn, drives a generator to produce electricity.

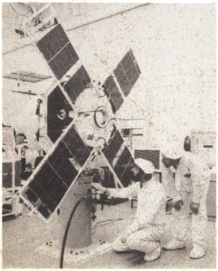
## Giant windmill nears completion

Lockheed Aircraft Service Company (LAS) has just announced delivery of two 18.5 metre aluminium blades to Block Island, off the Rhode Island coast (USA), for a wind energy installation there. The large blades were manufactured at LAS's Ontario, California, facility using aircraft technology, and are designed to operate in wind as slight as 12km/h.

Because of the heavy winds that Block Island experiences year-round, the wind turbine — part of a NASA/US Department of Energy test program — is expected to supply the island with up to 50 per cent of its' electrical needs. This amounts to some 200kW of electrical power.

Approximately 500 people live permanently on Block Island, with the population reaching around 5000 during the summer months.

## Satellite to search for "black holes"



*UK6, Britain's latest scientific satellite, undergoes final checks at Marconi Space and Defence Systems, England, prior to its launch last May. The UK6 mission is designed to last two years and will carry out research into high energy astrophysics. This will include "black holes" — huge gravity traps that swallow hundreds of millions of stars and from which nothing, not even light, can escape.*

## Westinghouse tests solar power station

A prototype heliostat, a device which gathers and concentrates sunlight, has been designed and constructed by Westinghouse Electric Corporation's Advanced Energy Systems Division. The device is now completing a 3-month test period at the US Department of Energy's Saudi Laboratory solar test facility near Albuquerque, New Mexico.

The heliostat is a part of a solar power station. In areas which enjoy abundant sunlight, electric utilities could use solar systems to meet a portion of the fuel needs for generating electrical power for the community.

The Westinghouse heliostat tracks, by computer controls, the Sun as it moves through the sky. The reflected Sun rays from a 4 x 9 metre mirrored surface are aimed at a target area on top of a central collecting tower 300 metres away.

When the sunlight strikes the power tower target, water is heated and converted into steam, which in turn drives a conventional electrical steam turbine-generator.

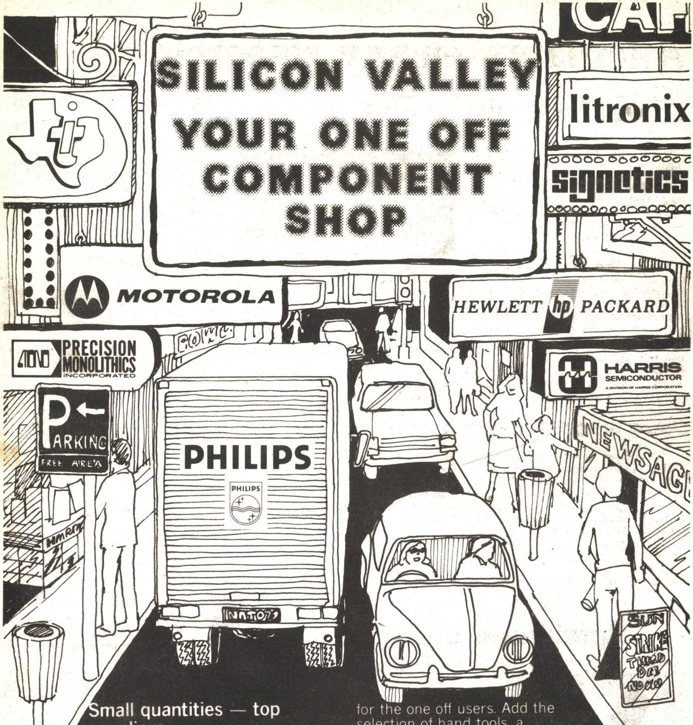
In a solar power plant for an electric utility, it is expected that 5,000 mirrored heliostats would surround a single power tower. This arrangement would generate up to approximately 50 megawatts of electricity, the equivalent of a quarter of a million barrels of oil per year.

## Automatic dialling for computers

Telecom Australia is to make it possible for computers to dial automatically through the Australian network for the transmission of data, facsimile and telemetry, but not voice messages.

Announcing this in Melbourne recently Mr Roger Banks, General Manager Customer Services, Telecom, said this would give business greater access to the cheaper after hour STD rates. It would also facilitate the collection of information by telemetry on a programmed basis throughout the day — such as water storage levels, weather information, etc.

Mr Banks said it was the first time computer originated calls would be allowed to go through the telephone network. The starting date for transmissions will depend upon the availability of approved equipment.



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## Being pushed ahead:

# THE PHILIPS COMPACT DISC

## Will it displace existing LP records and tapes?

**In the May issue, we made brief reference to a new digital super-quality audio disc from the Philips stable, a mere 115mm in diameter and using the same basic technology as originally developed for video recording. Now unveiled as the "Compact Disc", it is being presented by Philips as "the disc of the future".**

**by NEVILLE WILLIAMS**

If it lives up to its promise, the Compact Disc should ensure a much flatter frequency response and a much lower level of distortion than is realised with present-day pressings and pickups — and, for that matter, with present-day tapes. It should be substantially free from surface noise, largely proof against wear and handling, and with a dynamic range of up to at least 85dB — 25dB greater than with the best current pressings.

Performance of this order is, of course, not a Philips prerogative. Many companies have worked out ways of recording colour video signals on cassette or disc and, in so doing, have acquired the basic technology necessary to record ultra high quality, multi-channel audio.

Initial emphasis was on the video cassette but the market turned out to be a lot less rewarding than the industry had hoped for. This reaction has diverted attention to the video disc and also prompted a closer look at the ultra hifi audio option. (See our May issue, page 28).

While Japanese manufacturers are still posturing and arguing about video recording standards, there does appear to be a consensus in that country that audio discs should be of the same 30cm diameter as video discs, thus facilitating the marketing of compatible video/audio players. On an audio disc of that size, there would be encoding capacity to spare for very long playing stereo, discrete surround sound, &c. However, any such decisions can be taken only after the Japanese manufacturers resolve which basic recording method(s) will be adopted.

In the meantime, Philips have plotted a quite different course. They have launched their own laser type video disc player into the trial marketing phase through their American subsidiary, Magnavox. And, ignoring compatibility, they have unveiled their super quality audio record, using similar technology, but less than half the size of the video disc and involving a much smaller — and cheaper — playing deck.

Fairly obviously, they see the audio disc and player as being potentially small enough and cheap enough to attract a market in its own right. Their name "Compact Disc" evokes memories of their initiative in successfully launching the "Compact Cassette" in 1963.

Like the compact cassette, the new disc is apparently seen as catering primarily for the 2-channel stereo market. It could probably carry additional phase-encoded information but would need to operate to different parameters (eg, at a higher speed) to cope with additional discrete channels. That is something for the future, however. Right now, Philips are presenting their compact disc as a super-quality stereo source which need not be any more expensive than present-day quality players and discs.

Its attractive features are the direct result of a completely different method of recording and playback. All audio discs to date have used the "analog" method whereby the shape of the audio envelope is inscribed (or impressed) directly in the vinyl, then replayed with a stylus which physically rides in the modulated groove. Reflecting upon it, it is amazing that the system works as well as it does!

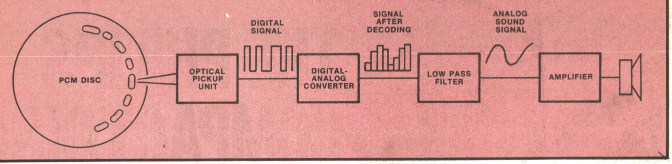
## COMPLETELY DIFFERENT APPROACH

In the new Philips disc, the signal is processed and recorded in a completely different way. The incoming audio envelope is first sampled at a rate well above the audible range, and the amplitude of each sample is translated into an appropriate digital number — rather like a series of voltage readings! The module which performs this task is referred to as an analog-to-digital (AD) converter; effectively, it takes in music and feeds out a high speed train of digital numbers which represent the shape of the waveform from instant to instant.

In turn, this train of digital numbers, in the form of pulses, is recorded by a laser on a photosensitive layer on the surface of a glass master disc. After development and etching, a chain of microscopic pits is left in the surface, strung along a spiral path, and varying in length and spacing according to the digital numbers they represent. To quote actual figures, the pits are 0.4um (micrometre) wide, less than 1um long and recorded in a spiral pattern with centre-centre spacing between loops of 1.6um.

Customer copies of the master are produced by precise but otherwise normal pressing techniques, using clear rather than opaque polyvinal chloride. However, the copies

## HOW THE COMPACT DISC SYSTEM WORKS:



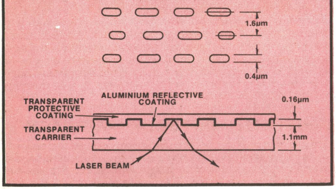
have to undergo two further processes: first, the surface carrying the modulation is coated with a very fine metallic layer to make it optically reflective; and second, a thin transparent coating is applied over the top of the metallic layer, purely to protect it.

The intention is that the encoded signals should be read, not through the protective coating but, from underneath, through the clear body of the disc. As a result, the bottom of the pits, rendered reflective by the metallic coating, appear as high points. The spaces in between are more remote and in a different focal plane.

The disc is played back by a head which rides just clear of the under-surface. A tiny beam from a laser diode in the head scans the spiral of pits and the reflected light is picked up by a photo-diode optical sensor mounted in the same head. The light intercepted varies according to the presence or absence of a pit so that the train of pits produces a train of equivalent digital signals from the optical sensor. These pass through digital-to-analog (DA) converter circuitry which changes the train of signals back into an audio waveform appropriate for a normal amplifier system.

In the foregoing explanation, a single audio signal has been assumed. For stereo, the left and right channel information is multiplexed so that the digital pulses record left and right samples in turn. The samples are sorted out as part of the DA decoding process.

## SIGNAL & OPTICAL DETAIL



In designing the laser optics, Philips ensured that the reading beam would be critically focussed onto the pits so that the information "pit" or "no pit" should be derived with the least ambiguity from the reflected light. Significantly, where the reading beam passes through the undersurface of the disc, its diameter is about 1mm. As such, dust particles, etc, tend to intercept only part of the beam and therefore not to interrupt the flow of "pit, no-pit" information.

In any case, a spurious impulse does not generate a direct noise component, as happens in an analog system. It may cause the amplitude of a sample to be misread but the effect of isolated wrong sample values is rounded out in the digital-to-analog conversion process, so that they are rendered inaudible. Philips say that the focus and tracking system will cope reliably with any likely degree of warp in the small disc.

Figures quoted for the Compact Disc indicate the use of a 14-bit code, which is capable of specifying the height of each sample to an accuracy of better than one part in 16,000. The sampling frequency is 44.33kHz. This adds up to 6 billion information "bits" on one side of a 13.5cm recording, and a playing time of about one hour. The recordings, by the way, are single-sided.

The encoding parameters ensure a high frequency response to 20kHz and an intrinsic signal/noise ratio of 85dB. However, the system also makes use of high frequency pre-emphasis and de-emphasis, increasing the figure to an effective 92dB.

As an intriguing variation from normal practice, the Compact Disc does not operate at a constant angular speed, but rather at a constant lineal speed. When the head is reading the innermost track at the start of the playing, the angular speed is 500rpm. However, as the head follows the spiral outwards, the speed gradually drops to about 215rpm. Mechanics play a secondary part in this: both the tracking of the head and the speed of the disc are controlled electronically by the flow of the information bits past the sensing optics.

Perhaps one more point should be made: With digital techniques being taken up by recording studios, it could well be that the discs could be recorded on a digital to digital basis, direct from the master tape(s). That would just about rule out the last chance of noise and distortion penetrating the chain between the mixing console and the input to the domestic hi-fi system.

So when are we going to be able to buy our first Compact Disc and player?

Right now, there's no straight answer to that question.

The first official announcement of the disc was in May 1978, at a seminar held in Eindhoven for technical journalists attending the Festival du Son. The journalists were apparently quite impressed by the quality of the reproduced sound although they were not quite so convinced that Philips would be able to establish a new and unique world standard on their own. Philips, on the other hand, expressed a willingness to co-operate by licensing hardware manufacture to other companies, much as they did with the compact cassette. However, there seemed to be little optimism that much would happen before the mid '80s.

More recently, however, Philips have indicated that the Compact Disc is being brought forward in time, almost certainly in response to the upset and confusion in the video market. They are now talking about official market release in 1980.

And the Japanese?

They are playing their cards very close to their respective chests. One thing only can be tipped. If any Japanese company does take up the Philips Compact Disc it will most likely be Matsushita, because of the working relationship between the two organisations — that is when they are not involved in do-or-die competition!

# Training our film &

**Although the centre of controversy when it was set up in 1973, the Australian Film and Television School quietly settled down to the serious job of training our future film and TV industry professionals. Its reputation for doing this job thoroughly is now growing fast, as the result of impressive work already achieved by its graduates.**

### by JAMIESON ROWE

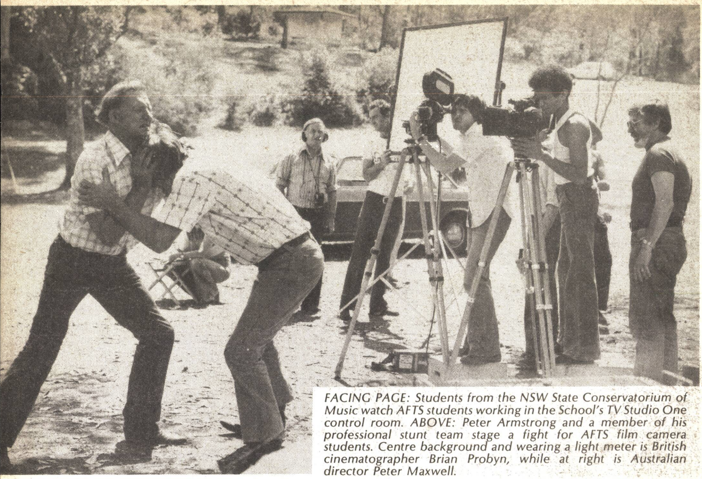
When the Australian Film and Television School (AFTS) was set up officially by an Act of Parliament in 1973, it was the subject of quite a deal of controversy. There were those in the existing industry who feared that it would be too academic in orientation and not give students sufficiently practical training. Others were unhappy about the way it had been set up, or with the composition of its interim Council. Still others were of the opinion that the film and TV industries required skills which could only be acquired by on-the-job training, and there was no need for a school of this type anyway.

Despite the controversy the School itself soon settled down to business. Its foundation director had already been appointed — Professor Jerzy Toeplitz (pronounced Ter-plitz), the distinguished film maker and co-founder of the highly regarded Polish National Film School. And in fact a group of 12 men and women was already undergoing an intensive one-year Interim Training Scheme (ITS), which was serving as a pilot for the proposed three-year Fulltime Program.

For a while the AFTS had virtually no facilities of its own, and the students had to train using studios and other facilities provided by the ABC, commercial TV stations, laboratories and film production companies. It was not until August 1975 that the School's present "temporary" premises were opened in North Ryde, about 15 kilometres north west of the centre of Sydney. By this time the first intake of 25 students had begun training for the three-year course.

Right from the start the emphasis at the AFTS was on practical training rather than theory. The organisation of the School itself was deliberately steered away from conventional academic lines, as part of this emphasis. The teaching staff were chosen and are still chosen for their professional experience, not for their academic qualifications — assuming they even have any. In most cases they are contracted to the School for a maximum of three years, to ensure that those in direct teaching contact with students are familiar with up-to-date techniques and technology.

To supplement the full-time staff, the School makes extensive use of visiting lecturers from industry. These include film and TV directors, producers, cinematographers, lighting and sound experts, production managers, actors



*FACING PAGE: Students from the NSW State Conservatorium of Music watch AFTS students working in the School's TV Studio One control room. ABOVE: Peter Armstrong and a member of his professional stunt team stage a fight for AFTS film camera students. Centre background and wearing a light meter is British cinematographer Brian Probyn, while at right is Australian director Peter Maxwell.*

# TV professionals...

and actresses — not only from local industry but from overseas as well. Both the BBC and Thames Television in London send experts to the School to lecture and train students each year, as part of continuing cooperation with the AFTS television training program.

Industry professionals from both the USA and Britain are brought to the School from time to time for seminars and training workshops. US film director Joseph Strick and actor Burt Lancaster have been involved in this way, as has the British cinematographer Brian Probyn.

AFTS policy is to engage professional artists for at least the key roles in student productions, to give the students experience in working with professionals.

On the student side, the School requires the sort of committment and hard work that would be expected from graduates if they become industry professionals. The Fulltime course is just that, and students may have to work long hours and at unusual times. However the School provides transport for location work, and Fulltime students are also paid living and dependants allowances.

The Fulltime course is also arranged so that students cannot simply elect to major in film or TV direction, without adequate experience in the other and more basic skills. They must "earn" the right to major in direction in the later years of the course, both by distinguishing themselves in the other areas and by demonstrating the appropriate qualities of maturity and aptitude for leadership and planning.

The businesslike approach adopted by the School has already begun to pay off, providing ample justification for the investment of public money it has required. Most of the people who graduated from the pilot ITS program have become well established as industry professionals, and some have notched up impressive successes.

One of the ITS graduates was director Gillian Armstrong, whose film "My Brilliant Career" was the only Australian film accepted as a competition entry at this year's Cannes Film Festival. As a total of only 24 entries were accepted from over 700 films from 50 countries, Ms Armstrong has thus gained considerable international prestige both for herself and the AFTS.

Another ITS graduate was director Phil Noyce, whose recent film "Newsfront" was widely acclaimed for its masterly integration of early newsreel footage with recently-shot dramatic material. A number of other ITS graduates have won prizes at both Australian and international film festivals for their productions.

And although the first group of three-year Fulltime Program students only graduated in 1978, these people have begun to make their mark also. Ms Peita Letchford is a director with the Reg Grundy organisation, working on the prime-time TV series "The Young Doctors" and "Prisoner". Marcus Cole, another 1978 graduate is also working as a director on "Prisoner", having also worked as an assistant director on the acclaimed "Against The Wind".

As a further testimony to the School's growing reputation, the latest 1979

# Training our film & TV professionals . . .

graduates have rapidly been snapped up by the industry. One day after their course officially ended in March, all four cinematography graduates were working — two with the ABC and two with Film Australia. Two of the four screenwriting graduates had professional writing assignments, while another four graduates had found jobs also.

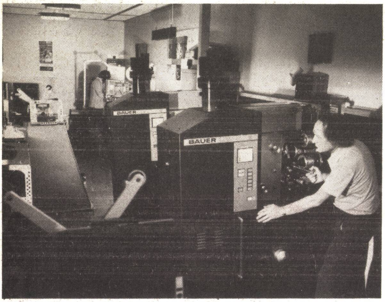
In view of this success story I was most interested a few weeks ago to accept an invitation to visit the School. Shortly afterwards I was able to spend an enjoyable morning looking over its facilities, with AFTS information and PR man John Howard as my guide.

As an amateur film enthusiast I was most interested to see the School's film facilities, as well as those for TV. Most of the facilities are centred around 16mm film production, although there is sufficient 35mm equipment to ensure that students have adequate experience using this gauge.

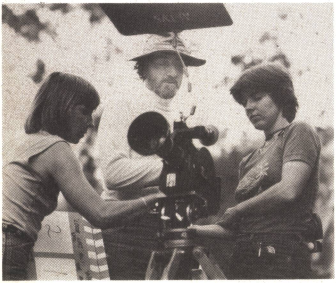
The School has a well-equipped sound dubbing theatre, with full facilities for re-recording, post-synchronisation and mixing of both 16mm and 35mm films. Full rock-and-roll synchronisation is provided between 35mm and 16mm projectors and an array of reproducing decks or "dubbers". The sound mixing desk has 12 channels, six of which are available for mixing down from the dubbers. A separate sound transfer suite has facilities for transfer between various tape formats.

The dubbing theatre forms part of a theatre block, which also comprises two small viewing theatres and a 99-seat cinema. All four theatres are grouped around a common projection room housing 35mm, 16mm and super-8mm projectors. The two Bauer U-3 35mm projectors serving the main cinema can project in standard, Academy wide-screen and CinemaScope aspect ratios, and were purchased from a grant of $24,000 made to the School by the Motion Picture Distributors Association of Australia.

There are 12 film editing rooms, each with at least one and generally a number of editing machines of both the flat bed and upright variety, in both 16mm and 35mm gauges. The School is also equipped with a vintage Oxberry aerial image animation machine, one of



*LEFT: The School's bio box, serving a dubbing theatre, two small viewing rooms and a 99-seat cinema. ABOVE: Experienced Hollywood director Robert Gist, head of the AFTS Fulltime Program, shown briefing actress Carmen Duncan.*



*Bill Constable, senior lecturer in cinematography, with first-year editing student Diana Priest and camera student Marian Redmond (right). The camera is a 16mm Arriflex 16SR.*

*Final-year students Ben Cardillo (left) and Steven Salgo with the Bosch-Fernseh broadcast-quality colour cameras attached to the School's outside broadcast (OB) van.*

only four in the world, which was purchased from the Eric Porter animation studios in Sydney and restored by AFTS staff. The machine has been modified to shoot in both 35mm and 16mm.

On the television side, the School has a broadcast standard studio with 320 sq metre floor area. The studio is equipped with four Fernseh colour cameras on Vinton pedestals, and fitted with 10:1 zoom lenses. A 42:1 zoom lens is also available, as are a crane and two dollies. The studio is fully soundproofed and has a double-doored truck entry. Its lighting capacity is 300kW, with 120 outlets controlled by a 60-circuit Thorn lighting console.This provides for both manual and computer memory operation, the memory having a capacity of 100 changes.

The vision control room contains a custom-designed switching console which provides a wide range of plug-in special effects, remote control of telecine chains and caption changing, and a message insertion generator. Also provided is an electronic videotape leader generator designed by AFTS technical staff.

Serving the main studio are four Ampex AVR-2 quadrature colour videotape machines. These are also interconnected with a computer videotape editing facility, based on a Central Dynamics Nova minicomputer.

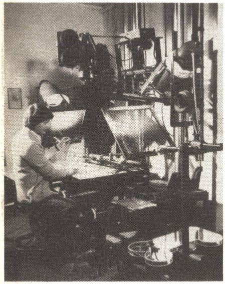
The main studio is supplemented by two smaller television studios which are provided with non-broadcast quality equipment — one colour and the other monochrome.

The School also has an outside-broadcast or "OB" van, fitted with an BCN videotape machine and a vision mixer with chroma-key and special effects. The van is also provided with a 12-channel sound mixer, three broadcast-quality Bosch-Fernseh portable colour cameras and an SMPTE time-code generator which makes it compatible with the main computer editing system.

To support the main film and television facilities the School has carpentry, set construction and staging workshops and staff. There is also a props store, a small music studio, a sound library, a reference library, a photographic darkroom equipped for colour processing, a super-8mm film processor and comprehensive equipment for the preparation of graphics. Needless to say there is also a staff of assorted technical experts to keep all these facilities going, headed by technical services controller Alan Morrison.

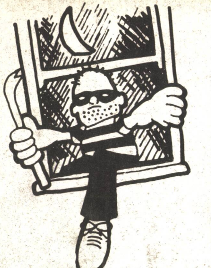
During my tour of the School with John Howard I also learned more about the courses offered by the AFTS. Apart

*One of the School's better-known ITS graduates is director Gillian Armstrong, whose film "My Brilliant Career" was the only Australian entry accepted at this year's Palme d'Or competition at Cannes. Here she is working with recordist Bob Hayes, cinematographer Bill Constable and camera student Richard Michalak.*



*AFTS staff cinematographer Graham Edwards at the School's vintage Oxberry animation machine, which came from the Eric Porter animation studios in Sydney.*

*RIGHT: The School's dubbing theatre, which is equipped with both 35mm and 16mm projectors and Magnatech rock-and-roll dubbers.*



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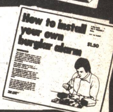
**Copies are available for only $1.50 from any Dick Smith Store or re-seller**



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# Training our film & TV professionals . . .

from the three-year Fulltime Course for training professionals, there is also an Open Program which runs a whole range of courses. Many of these are designed to provide training in film and video techniques for people who need to use these media in other vocations.

Some of the Open Program courses are designed for people who are already employed in the film and TV industry, who may need in-service updating or retraining. Such courses generally cover specialised areas of expertise, such as lighting techniques, editing, sound recording or production management.

Other courses are designed for teachers, training officers and similar people. These include basic and advanced 16mm film production, super-8mm production, monochrome video production, colour video production, animation, script and narration writing, and understanding the media.

An important part of the AFTS Open Program is the National Graduate Diploma Scheme. This is aimed primarily at graduates currently teaching in primary and secondary schools, although places are also reserved for educationalists in TAFE, health and community education. The AFTS operates this scheme in NSW, Victoria and Western Australia, in conjunction with cooperating tertiary institutions. It is hoped to extend the scheme to all States in the future.

*ABOVE: Open Program students working in TV studio 2, which is equipped with Ikegami cameras. This studio and a small monochrome studio are housed in a building a few doors down the street from the main AFTS building.*

*RIGHT: Senior student and camera major Erika Addis operating one of the three portable broadcast-quality colour TV cameras attached to the FTS outside broadcast van.*

*Students at the control console of the School's computer controlled videotape editing system. Based on a Nova minicomputer visible in the rack at right, the modified Central Dynamics system was supplied by Philips.*

A final point of interest. During my visit to the School, I learned that there are still some vacant positions for the March 1980 intake of Fulltime Course students. There have been a large number of applications for positions which involve camerawork and editing as the initial major strand, but not as many for the positions which involve sound as the major strand.

So if you have a burning desire to get into the film and TV industry, and particular interest and background in the sound side, why not consider applying to the AFTS for one of those coveted positions in the 1980 intake?

You'll have to be quick, though — applications close very soon, on Wednesday July 4.

If you're interested I suggest you waste no time in contacting the Recruitment Officer, Australian Film and Television School, P.O. Box 126, North Ryde NSW 2113. You can also telephone them on Sydney (02) 887 1666, or Melbourne (03) 328 2683.

# Satellite terminal comes on a truck!

**Engineers at the Independent Broadcasting Authority, London, have chalked up a notable European first: the use of a transportable earth station to transmit a TV newscast live via the European Orbital Test Satellite (OTS). The new station comes mounted on the back of a truck.**

### by PAT HAWKER

On Monday, September 25, 1978 ITN's 5.45 pm news bulletin created its own news.

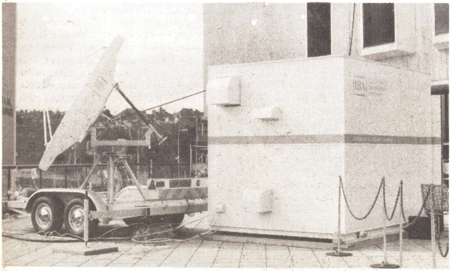
That afternoon the bulletin was prepared at an extempore newsroom — tables and telephones — set up on the Independent Broadcasting stand at the 1978 International Broadcasting Convention at the Wembley Conference Centre in north-west London. It was presented by Leonard Parkin from the terrace, standing beside a saucer-like object mounted on a trailer alongside a small cabin.

It was this hardware, completed only a few days before, that beamed the newscast up, up and away: all the way to a tiny object 36,000km above Libreville in equatorial Africa, the European Orbital Test Satellite (OTS) launched last May. Within OTS the signals were amplified and processed before being sent back to large listening "ears" at Goonhilly, Cornwall and Fucino, Italy, and from there to ITN House in Central London. A round trip of well over 80,000km to arrive safely and in perfect condition just a few short kilometres away from Wembley.

It was the first time such a station had been built and used in Europe.

This may perhaps seem at first glance only a small step in space technology. Yet it is not one that should pass unnoticed: it is highly indicative of the progress that is still possible in the unfolding story of how instant "live" news may increasingly reach TV screens in Britain from anywhere in Europe.

Was the journey really necessary? Not, in truth, from Wembley, since perfectly good terrestrial picture circuits exist from there into Central London. But such circuits, even in this era of universal telecommunications, are far from common. Even in London, the number of buildings permanently linked to the television distribution network is quite small: in many cities and over much of the countryside such facilities are not available at short notice. For outside-broadcasts the British Post Office or the ITV companies set up special microwave links, often encountering many problems when the site is hemmed in by buildings or hills, or is a previously untried location.



*The IBA's new transportable earth station's 2.5 metre antenna is trailer-mounted.*

Temporary microwave links are limited in their distance from the main network — a single "hop" can seldom exceed 50km and, in many situations, may have to be far less. Considerable expertise and time may be required in setting up and checking these links, particularly the first time from a new location.

Such limitations are not acceptable for "live" news coverage. In the United States where the use of lightweight electronic news gathering (ENG) techniques is now common (ENG has been slow in coming to the UK for industrial as well as for engineering reasons), a good deal of effort has been put into establishing, in some cities, facilities for microwave links which can be set up rapidly from different sites: however, even so it often taken 15-30 minutes or more to achieve good quality circuits and difficulties are often experienced, particularly near high buildings.

New York City, for example, is fraught with problems — not only because buildings obstruct but also because they cause reflections in the form of multi-path "ghosts". The base antennas have become increasingly complex to achieve sufficient "gain" in all directions and the mobile units more and more elaborate in order to minimise mutual interference between rival news crews. In practice, "live" coverage is often not achieved from the location of the news event, with crews dependent on either taking video tape cassettes all the way into the central news rooms or driving to a more favourable site and then "microwaving" them part of the way.

During 1977, Independent Broadcasting Authority (IBA) engineers at Crawley Court began thinking about this problem and how pictures could be brought in more readily and more rapidly from major news events or remote locations. To Brian Salkeld, head of the IBA's network planning section, the answer seemed clear: the best way of providing high-quality television circuits from anywhere in Western Europe — indeed from Iceland to North Africa — would be by using the next generation of European satellites.

Already, from time to time, some use had been made of transportable satellite terminals for world events: pioneered in 1968 during the visit by Pope Paul to South America and later to Africa. There was also the ship-borne terminal that brought us pictures of space mission splash-downs in the Pacific, and the packaged terminal flown to Peking for Nixon's visit. Then again the Americans had installed a dish antenna at Kansas City during the Republican Convention of 1976, working via *domestic* satellite systems. The Japanese had announced their intention of building both transportable and mobile experimental space stations for use in conjunctiom with the new higher-frequency (14GHz) Broadcast Satellite Experiment (BSE) satellite launched last year.

But no European broadcaster appeared to have any plans for such experiments with the European Orbiting Test Satellite (OTS), finally launched in May 1978; OTS is intended as an experimental spacecraft, opening the way to a Eurovision space distribution system and also to a later "H-sat" spacecraft for experimental broadcasting direct-to-the-home from space.

A dedicated European television satellite, it was felt, could overcome the major practical drawback to the current use of international satellites for news and program distribution: the very high charges (amounting to over £1,000 for a 10-minute booking) involved in using the world-wide Intelsat system with its network of enormous fixed ground stations.

It is not always appreciated, even by broadcasters, how much of the potential value of satellites has so far been lost to us for economic reasons. "Live" program exchanges are still restricted to occasions which can justify the high costs or are of such universal appeal that the charges can be distributed among many broadcasting organizations. Satellite circuits still cost much more than air-freighting video tapes: but yesterday's news is 24 hours too late.

But if Eurovision satellites could be accessed immediately by relatively low-cost terminals the situation would be very different. Once the satellite is in place the cost of sending pictures from Wembley to ITN House need be no more and could conceivably be less than using conventional mobile microwave links. While it may be still some time before such facilities would be used for ENG work, there is *at present* an important unsatisfied demand for temporary circuits for major events of world-wide interest.

A first step is to investigate thoroughly the practical engineering problems of operating a high power 14GHz transportable station. What will be the reliability? Can a small dish antenna provide sufficient concentration of energy, with minimum spilling of energy outside the main beam? How long need it take to set up a high-quality television circuit from a new site? Will there be problems of compatibility between a 2kW 14GHz transmitter and the nearby sensitive video and camera equipment? In how many sites will it prove difficult to obtain a clear unobstructed view towards the distant satellite? Is there a problem of interference with local telecommunications links?

A paper exercise may provide clues, but can seldom give definitive answers to such questions. To find the answers, IBA engineers built the first transportable self-contained earth station in Europe. A 2.5m diameter dish antenna is mounted on a trailer. The associated high power (1.5-2kW) 14GHz transmitter is built into a container-cabin which can be carried to the site on a medium-sized lorry. The station can be operational within minutes of arriving at its destination; using the beacon transmitters carried on the OTS satellite to carry out accurate adjustment and alignment of the antenna.

The preliminary results achieved at IBC78 show that television pictures of the highest quality can be transmitted from this transportable unit up to OTS and down again to relatively compact earth stations such as the experimental station built in 1977 at Crawley Court. As an additional experiment, Oracle teletext signals were successfully transmitted as part of the video waveform — the first time that teletext has ever been sent via a satellite.

There is an important international regulatory problem that must be overcome before transportable and mobile space stations can become a normal and everyday part of the broadcasting scene. At present the Radio Regulations make no specific provision in the 14GHz frequency band for mobile stations and the frequencies are shared with terrestrial microwave links.

Such a restriction effectively prevents, at present, the use of mobile space stations for news gathering. But it is a man-made regularion and could be changed. A regulation permitting mobile operation in the GHz band is all that is necessary, and would inconvenience few other users. Let us hope provision is made for this at the important World Administrative Radio Conference due to open in Geneva next September.

---

This article originally appeared in "Independent Broadcasting", published by the Independent Broadcasting Authority, London.

**if
you're
listening
to
AM
through
an
ordinary
tuner...**

**you're not
even getting
half the story!**

You've always thought of AM radio as sounding dead, flat, lacking in audio quality, right? That's probably because you've been listening through a conventional tuner, which, even if its FM is of very high quality, probably has an AM frequency response that rolls off sharply above about 2-3 kHz. *In other words, not even half the broadcast audio band.* The Audiosound AM101 covers the full 9 kHz band (± 2 dB), plus it has a balanced low noise aerial system for lower interference. This means that under good conditions, AM *audio quality* is virtually indistinguishable from FM! If you want the best of both worlds, then there's our AM/FM tuner, the Audiosound T751. *Both tuners give vastly superior audio quality, better sensitivity and lower noise, on AM, than any other tuner available.*

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If you're a service technician, or even a hobbyist who likes to tinker, Dick has a range of products just for you. Products such as the aerosol service aids below: they'll make your job easier and quicker!

## 'CANNED COLD'

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Cat N-1056 .................. **$3.00**

## FREON SPRAY

This is a very handy product to have around: it cleans, degreases, andremoves moisture, is non-toxic, non-explosive and inflammable. It won't harm components or surfaces (inc. rubber & plastic) and leaves no residue. Complete with long reach nozzle, 250g can.

Cat N-1051.................. **$3.00**

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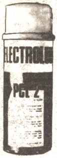

## PCB LACQUER

This is a spray-on lacquer for protecting printed circuit boards from tarnishing. Furthermore, you can solder through this (unlike many other circuit lacquers). 397g can.

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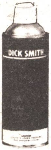

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The winner of the Exidy Sorcerer Computer from the Sydney Home Computer Show is:
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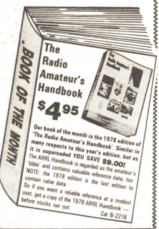

The Radio Amateur's Handbook

**$4.95**

Our book of the month is the 1978 edition of 'The Radio Amateur's Handbook'. Similar in many respects to this year's edition, but as it is superseded YOU SAVE **$9.00!**
The ARRL Handbook is regarded as the amateur's 'bible' and contains valuable reference data, too.
NOTE: the 1978 edition is the last edition to contain valve data.
So if you want a reliable reference at a modest cost, get a copy of the 1978 ARRL Handbook — before stocks run out.
Cat B-2218

# WATCH THIS SPACE

AND FIND OUT WHAT YOU MISSED

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## LAST MONTH:

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**$2.62**

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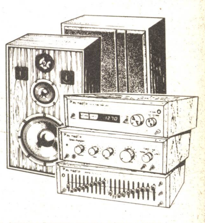
Our newest Playmaster kit: and it looks like being one of our most popular! This remarkable device allows you to tailor the frequency response of your system to suit your surroundings. Sound EXACTLY the way you like it.
NOTE: Stocks of this kit may be limited at some stores due to incredible demand.

Cat K-3500 ........................................ **$99.50**



### PLAYMASTER SPEAKER KITS:

3 types to choose from. 75 litre (300mm) 3-way; 53 litre (250mm) 3-way; and 26 litre (200mm) 3-way.networks. Any of these systems can be completed by virtually any constructor in less than 2 hours total work. Full instructions are provided (no soldering required.) Largest system features mid-range & tweeter controls.
NOTE: Enclosure (box) kits and speaker kits available separately if required.

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TOTAL SYSTEM PRICE (per pair):........................ **$284.00**

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Speaker Kit: Cat C-2044 .... $125.00 pr. Box Kit: Cat C-2624 .... $99.00 pr
TOTAL SYSTEM PRICE (per pair):........................ **$224.00**

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Speaker kit: Cat C-2046...... $70.00 pr. Box Kit: Cat C-2626...... $79.50
TOTAL SYSTEM PRICE (per pair) ........................ **$149.50**

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L-5090

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## BOOST CAR STEREO SOUND

● 30 watts maximum power to each channel ● Easily connected to your car stereo ● Huge heatsinks for heat dissipation ● Works on any 12V DC negative earth car ● Small size 118(W)x40(H)x165(D)mm ● Contains 4 IC's - all solid state.

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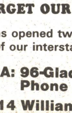

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**BUILD YOURSELF A COMPUTERISED DOORBELL . . .**

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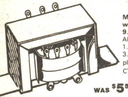
**You probably imagined our multi-tap transformers only gave the voltages shown on them . . . WRONG!**
Our transformers give a huge range of voltage combinations. It's just a matter of picking certain taps to get the voltages you need. So even if your requirements seem a little 'strange' you can probably get the voltage you need from a quality Dick Smith multi-tap power transformer.



**M-2155: nominally 15V @ 1A with taps at 6.3V, 7.5V, 8.5V, 9.5V, 12.6V & 15V.**
Also gives the following: 1.0V, 1.2V, 2.0V, 2.2V, 2.4V, 3.1V, 3.2V, 3.5V, 4.1V, 5.1V, 5.5V, plus 2.0V CT, 12.6VCT, & 15.0V CT – **a total of 21 combinations!**

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**M-6672 nominally 30V @ 1A with taps at a 15V, 17.5V, 20V, 24V, 27.5V & 30V.**
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# LCD CLOCK MODULE

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**$12.50** X-1039

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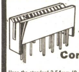

## 11 Way Edge Connector

Uses the standard 2.54mm (0.1) spacing, has 11 pins in 12 possible positions. With keyway that can be moved if required. Place in series for up to 110 way. Gold plated connecting pins.

**WORTH OVER $1.50 EACH!**
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**Ceramic equivalent: 80c each!**

**60¢ ea**
Cat D-5300

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**REAP THE BENEFIT of Dick's incredible bulk purchasing power. Here are just a couple of extraordinary bargains for YOU!**

## 2200uF/50V electros

How much would you expect to pay? $2.00, even more? You cna buy these from Dick from 80c each. They're ideal for power supplies, etc. Famous 'Rubycon' brand. R-4575

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**SUPER SPECIAL:** 2114 Memory IC's at almost half price: 4k static RAMs ideal for the experimenter were $14.50 **NOW $7.90**
Be quick for this bargain! Cat Z 9306

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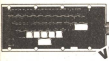
# NEW!



**$17.50**

**VALUE!**

## 'VIDEO BRAIN' COMPUTER KEYBOARD

**Full function computer style keyboard with 37 keys, silver plated double sided board, double sided edge connector (0.1" spacing) and high quality computer-grade push buttons with intechangeable key tops.**
The manufacturer of this quality keyboard went broke and we bought the lot. **You reap the benefit!** This keyboard must have cost twice as much to manufacture as the price we're asking for it! All keys can be individually accessed by cutting PCB tracks. **Come on all you experimenters: you've been asking for this — so here it is!** Cat X-1182

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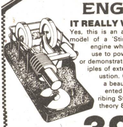
WHAT'S NEW

# HEAT EXCHANGE ENGINE



**IT REALLY WORKS!**
Yes, this is an actual scale model of a 'Stirling Cycle' engine which you can use to power models, or demonstrate the principles of external combustion. Comes with a beautifully presented book describing Stirling Cycle theory & operation.

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WHAT'S NEW

# IN ONE WORD . . . BRILLIANT!

## MINI HI-FI SPEAKERS

They might be mini size, but they're huge in
They might be mini sized, but they're huge in performance. And they compare favourably with speakers costing three times as much! 2-way sealed enclosure in smart aluminium (so they're robust) with a 100mm woofer, 25mm tweeter, enclosure measuring 120 x 120 x 190mm. Ideal for cars, caravans, boats, flats, etc etc etc.
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**99.50 pr**

**(Compare close equivalents at up to $350.00!!**

Cat A-2375

STOCKS DUE IN END JULY
PLEASE RING STORE TO CHECK!

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# DICK'S OWN "GOLDEN ROD" TV ANTENNA

***EXCLUSIVE TO DICK SMITH!***

**$29.50**

Cat L-4022

If you live in the metropolitain area or even a fringe area, then this is the antenna for you. It will give excellent results. Maximum gain on channels 0,2,7,9 & 10, with GOLD ANODISED elements for extra long life. 300 ohms impedance; complete with mounting bracket.

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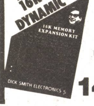

# UPGRADE YOUR TRS-80, APPLE OR SORCER TO 16k RAM

**(or your 16k Apple/Sorcerer to 32k!)**

Cat X-1185

***WHY PAY MORE?***

**149.50**

**You can install this expansion kit yourself and save $250.00! Others charge $430 and more to fit this simple kit. . .**
All our ICs are guaranteed brand new, prime spec devices. Don't be conned into paying a fortune! Kit as supplied suits Sorcerer and Apple. To upgrade TRS-80 you will need 2 DIP switches, Cat S-1608 @ $2.57 each.

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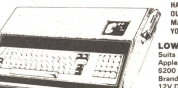

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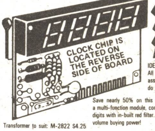
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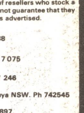
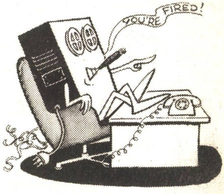


# Forum

Conducted by Neville Williams

## *The height of human indignity: Being bossed around by a computer!*


YOU'RE FIRED!

**Who amongst us has not been moved at times by the sight of galley slaves (Hollywood "extra" variety) cringing sullenly beneath the lash? Less dramatic but more to the point, in these modern times, is the way in which society is tending to submit (cringe ?) to machines of its own creation — to computers!**

I am well aware that the above introduction is an emotive statement of an emotive issue. What worries me is that it can come uncomfortably close to the truth. Citizens are constantly being affronted, inconvenienced and disadvantaged by the output from these "inhuman" machines. All too frequently we are compelled to fit in with them, rather than they with us!

Time and again, their programmed response is totally inappropriate to the occasion: like that of the computer which despatches hundreds of "Final Demand" notices, irrespective of the fact that payments are being held up by a postal strike.

Or take the case of a pensioner I met recently. She was being harassed by computer-initiated demands from a public utility, while trying simultaneously to sort out a gross and obvious overcharge! To a person of advancing years, it proved to be a most bewildering experience.

One could collect a large bundle of such examples, without much trouble, but I doubt that many would top the recent experience of a member of our own technical staff.

Here's what happened.

In May 1977, he received a renewal notice for the insurance on his car, a 1974 Torana LH 3300cc, 6-cylinder automatic. The premium was agreeably modest, which caused him to look more carefully at the document. Surprisingly, the agreed value was shown as $2800 — a long way below the then market value of the vehicle.

Accordingly, he rang the company concerned and was informed that their computer showed the car as being a 4-cylinder manual model. Where, along the line, it had assimilated that piece of misinformation was not obvious. However, they confirmed the correct valuation as $4500, quoted the appropriate premium, and undertook to put the records straight. He was instructed to endorse the invoice with the new figures and to send in a cheque for the new amount. They would take it from there.

This he did forthwith, logically expecting the matter to be set right.

But such was not to be. A few days later he received a refund cheque for $20.37 endorsed "Premium Adjustment". With it was a receipt carrying the note "Overpayment".

His response was to write a carefully worded letter to the company, explaining the apparent misunderstanding, and inquiring as to the present status of his policy, the basis of the premium adjustment and the agreed valuation on his vehicle. He repeated the information about its type, year of manufacture, model number, etc.

If speed means efficiency, they were very efficient!

By return mail they explained that, following his urgent representations, they had re-valued his car at $3350, which was the maximum amount which their valuators would consider on a 4-cylinder manual Torana. This formed the basis of the revised premium and they trusted that it "meets with your requirements".

It was patently obvious that the people concerned had totally ignored his statements on the phone and in the letter as to the true nature of the vehicle. Their reaction had been to initiate a computer print-out and, when this indicated a Torana 4-cylinder manual, this is what it had to be. Their minds were closed to any other possibility!

Not surprisingly, our staff member was quite hostile and he wasted neither time nor words in telling them what he thought about their methods. It was a worthy effort. A few days later he received a further letter confirming that his policy had been endorsed for $4500 and that this figure would apply until it was due for renewal in May 1978, eleven months hence.

But guess what happened in May 1978?

Along came a renewal notice showing an agreed value of $3000 — presumably written down from the previous $3350 — the maximum they would consider on a Torana 4 manual!

So to another telephone call which this time, produced the explanation that the information in the computer could not be changed. They would issue an amended renewal notice from the desk showing the correct figures. This duly came was paid and that was that until May 1979.

Came May 1979 and, with it, a renewal notice showing an agreed value of $3100 and a premium to match. As far as the computer was concerned, our staff member is still driving a Torana 4 manual in prime condition and, agreeably, it had appreciated slightly in value during the past twelve months!

How generous . . . and how utterly ludicrous.

Presumably the insurance company staff cannot — or will not — alter the computer records, nor can they invoke any procedure to prevent the faulty renewal notice from being despatched. They simply forget about it until the customer complains next year, then generate a substitute document manually.

I'd be fascinated to know how they've kept the faulty entry alive all this time. They must surely have been diverting to the computer that exact proportion of the premium necessary to cover the mythical Torana 4. Otherwise, the computer would have insisted on despatching a refund, or issuing a final reminder prior to invalidating the policy!

The company is now in receipt of a letter from our staff member which commences thus:

*Dear Sirs,*

*I have, on the whole, found your organisation to be efficient and courteous. However, you and your computer have contrived a plot which, I am sure, has been deliberately designed to "drive me bananas."*

*In 1976, when I took out an insurance policy on my six cylinder automatic Torana sedan, someone told the computer that it was a four cylinder model. I don't know where the other two cylinders went; maybe they fell off . . .*

Despite the good-natured opening, the letter went on to demand firmly that the company take whatever action was necessary to correct the situation once and for all, so that he could be relieved of what had become an annual hassle. Failing that he would have to make other arrangements.

## POLARISATION OF FM ANTENNAS

*In response to your article "FM signals, FM antennas and all that jazz!" in the April 1979 issue of Electronics Australia, I would like to contribute some information on FM polarisation.*

*Since December 1978, public broadcasting station 4ZZZ-FM has been radiating a circularly polarised signal from its transmission site at Mt. Coot-tha Brisbane. In March 1979, public broadcasting station 4MBS-FM began radiating a horizontally polarised signal from the same site. This situation has provided an opportunity to compare different aspects of the two polarisations both qualitatively and quantitatively.*

*(The Broadcasting Engineering section of the P&T Department did not oppose the use of circular polarisation for 4ZZZ-FM, but did require that the permitted radiated power be taken as the sum of the horizontal and vertical components rather than the larger of the two as is the case in other countries using circular polarisation. It is anticipated that as a result of current investigations, the P&T Department will alter that ruling to conform with international practice.)*

*Field strength measurements of horizontal and vertical components of both stations at a large number of locations around the Brisbane area have shown the following results -*

*CIRCULARITY OF 4ZZZ: Vert. component -1dB rel. to hor.*
*"CIRCULARITY" OF 4MBS: Vert. component at least -16dB rel. to hor.*
*(Above measurements in open with no obstructions in path)*
*4ZZZ AVERAGE V/H RATIO (for all measurements) -5dB*
*4MBS AVERAGE V/H RATIO (for all measurements) -9dB*
*4ZZZ MAXIMUM V/H RATIO (over all measurements) -13dB*
*4MBS MINIMUM V/H RATIO (over all measurements) 0dB*

*In the course of the measurements the following observations were made:-*

*(a) In areas where the path to the transmitter was obstructed by forested country, the vertical component of the circularly polarised signal was more heavily attenuated than the horizontal component (by an average of 6dB).*

*(b) In areas where reflections were in evidence, the vertical component of 4MBS was increased significantly and exhibited a marked standing wave pattern. (This was not the case with the circularly polarised signal as the main vertical component would tend to mask the reflections).*

*(c) Mobile listening tests have shown that multipath distortion (a problem in hilly Brisbane) is far more in evidence on the horizontally polarised signal than on the circularly polarised one.*

*These observations point to the obvious conclusion that some form of mixed polarisation is required to serve the various types of listeners to FM. From an economic point of view, circularly polarised transmitting antennas are significantly less expensive than slant polarised systems.*

*One would therefore expect that circular polarisation will become the "norm" of FM broadcasting and the authorised power of the horizontal component will be the same as that authorised for a purely horizontal system. I doubt that even EA readers would build a circularly polarised receiving antenna, but then again we technology freaks are a strange breed!*

*Ross Dannecker*
*Consulting Engineer*
*P.B.A.A. Qld.*

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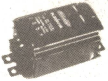

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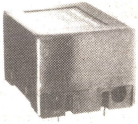

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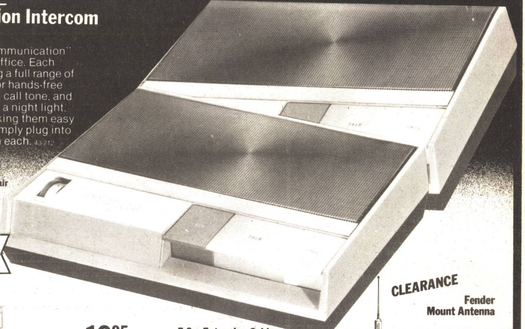

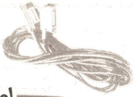

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## FORUM: Being bossed around by a computer!

As he points out: what if he hadn't noticed the inappropriate valuation and the vehicle had become an accident write-off? Worse still, what if it had been stolen? It was hassle enough trying to pay an additional premium, let alone convincing the insurer that a missing vehicle was something other than what their computer insisted!

And what if he now tries to reinsure with another company, on the basis that he is currently enjoying a full no-claim bonus. If they seek to verify it with the original insurer, the chances are that they would get computer sourced information indicating that there has been no recent claim against insurance policy number such and such, on a Torana 4 manual!

Behind situations like this is a multi-faceted problem involving, not just computer(s) but the whole efficiency and attitude of those responsible for setting them up and using them.

I started out by deploring our tendency to submit too easily to computers. Perhaps I should really be deploring the isolation, which computers foster, between people requiring service and those in the business of providing it.

Computers have become, at the one time, a symbol of progress and an excuse for just the reverse.

It would seem that one major source of hassle lies in the fact that many computer systems have not been set up to cope with an adequate range of real-life situations. They work fine as long as the anticipated routines are followed; what they frequently can't handle are the unexpected "human" exceptions to the rule.

The average computer system finds no problem with a change of address; it's been programmed to expect, accept and assimilate new data of that kind.

It also expects magazine subscribers to renew their subscription at the appropriate time and will either continue or terminate the postings as appropriate. But it may not expect subscribers to cancel their subscription part way through their currency. Have you ever tried to simply stop something that's being mailed automatically to your address?

Or maybe you've been the victim of a postal strike, or a cheque that's gone astray, or an argument about the validity of an invoice. You may well have been arguing with a human at the counter while a machine out the back somewhere was despatching reminders, a final demand and maybe an instruction to an employee to terminate a particular service. It's like trying to deal simultaneously with Dr Jekyll and Mr Hyde!

Clearly, in such situations, there is an access barrier between the staff and the system. It becomes a toss-up whether to blame the original programmer, or the person responsible for spelling out operational requirements — or management for insisting that the costly system be commissioned faster . . . faster!

It may even be that, in some situations, the computer has been quite deliberately invoked as an excuse for cutting down on some traditional (and mildly troublesome) services. In these days of high labour costs, rationalisation may indeed be necessary, but it's not good for the image to admit to it.It's much easier to say: "We can't do that now we're on computer!"

Yet another aspect is the attitude of office staff to the computer system — and this is the one which worries me at least as much.

A computer system may be seen as impersonal, implacable, imposing its own routines. Humans supply it with information and it proceeds to make the decisions and take the initiatives. There is a strong inclination to let it do so; a minimal incentive — or ability — to interrupt the automatic response and to inject some modifying factor; an unwillingness to over-ride its verdict.

The inscrutable grey box is king.

We — the public — are not expected to object. We should merely nod meekly and say "Oh I see!".

Maybe it's time that we started thumping the counter and demanding a more human response to our human problems.

Computers are fine as repositories of information and for jobs like sorting and number crunching. As robot dictators . . . yuck!

### FM POLARISATION

To change the subject, we are indebted to Mr. Ross Dannecker of Brisbane for his observations on the two Brisbane FM stations. Being of similar power and co-sited, they would certainly provide a basis for effective comparison of horizontal and circular polarisation for transmitting antennas.

The position in Sydney is more obscure because the two comparable stations 2MBS and 2CBA are in quite different locations. Even so, those reports we hear from mobile listeners generally tend to favour 2CBA, with its circular polarisation.

The body of support behind the approach certainly seems to be growing and it will hopefully only be a matter of time before it receives official P&T endorsement.

FOOTNOTE: In conversation, Mr. Dannecker says that the figures in his letter apply to the normal service area of the stations, representing a radius of about 40km from the transmitting antennas.

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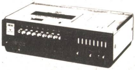

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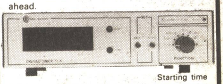

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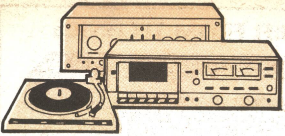


# Hi Fi Topics

# THE PROBLEM OF SUBJECTIVE REACTIONS: GOLDEN EARS OR A FERTILE IMAGINATION?

A hifi writer needs to be extremely cautious when discussing subjective reactions to equipment, as distinct from objective measurements. It is so easy to discount valid observations or, again, to be guilty of perpetuating rubbish.

**by NEVILLE WILLIAMS**

Time and again, overseas writers refer to the problems posed by people who claim that they can hear an effect which is not apparent to others and which is at variance with normal expectations. (e.g. Julian D. Hirsch in "Stereo Review" for May 1979).

Hirsch freely concedes that individuals may possess a special acuity of one kind or another but says that, equally, he is often put off by the inconsistencies and the "unbelievable excesses of hyperbole" which sometimes characterise the statements of those who claim to hear what he cannot.

I know only too well what he means. The fact is that, if one were to attempt to prove or disprove such claims, it would be necessary to organise meticulous double-blind tests to probe whether the claimant can indeed hear a difference. But that's only part of the story — in some cases the easy part.

Given that a difference is verified, it is then necessary to establish which aspects of it are "right" and "wrong". This may well involve detailed objective research to establish cause and effect — and findings which may or may not align with the claimant's original ideas. A classical example of all this was provided recently by subjective reactions to those exotic and expensive low-loss, high fidelity loudspeaker cables. Despite the fact that static measurements predicted otherwise, many claimed to hear a quite substantial difference (an improvement, of course) when the cables were installed.

I suspect that some desperately needed to hear a difference, having just spent a considerable number of dollars on the exercise! Perhaps there were others who could indeed detect a slight improvement in level or balance, particulalary if their existing cables were unduly lossy.

But measurements of typical cables established that the most significant difference was not a reduction in resistance and inductance(both steps in the right direction) but a large increase in capacitance (a step in the wrong direction!). It further transpired that this increase in capacitance was sufficient to push some amplifiers towards (or into) an unstable condition in the supersonic region. There was good reason to believe that some of the ultra-subtle "edge", which allegedly appeared on the reproduced sound, was not due to a loss made good but to the presence on the sound envelope of bursts of supersonic oscillation!

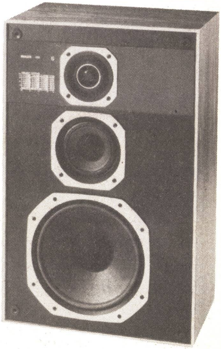
In such a case, the "difference" would not represent a subtle improvement but a subtle retreat from real fidelity!

But that statement should not be interpreted to mean that the "golden-ear" boys are always wrong. The reverse can happen, as it did with claims, made some time back, that some phono turntables sounded better than others! Musically, that is . . .

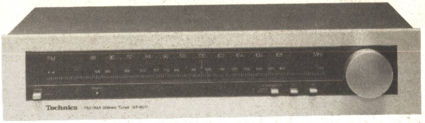
The initial reaction to this claim was one of incredibility. Surely someone had taken leave of their senses in both auditory and logical terms. The role of a turntable was purely mechanical: to spin the disc as accurately and smoothly as possible. Provided it did so with no

## A NEW PHILIPS LOUDSPEAKER SYSTEM

*As distinct from their unique "motional feedback" loudspeaker system, and others involving conventional passive crossover networks, this latest release employs what the company describes as the "natural crossover" technique. Philips Hifi Product Manager; Arno Reiuwers, explains that it relies on the inherent response and impedance characteristics of the three dirvers to absorb and radiate its share of the drive power across its appropriate portion of the spectrum. Backed up by careful enclosure design, it obviates the need for a comprehensive (and expensive) crossover network which gives place to just a couple of high-pass capacitors. Mr Rieuwers added that the new Philips loudspeaker factory at Dendermonde in Belgium has the necessary research and productions skills to exploit the natural crossover system, leading to a product that will have an immediate appeal to the budget-conscious hifi shopper.*



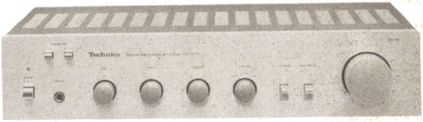
## SLIMLINE HIFI FROM TECHNICS

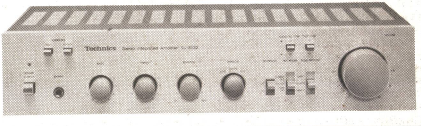


*Catering for those who dislike the ponderous "technical" theme in hifi equipment, Technics are now offering the "slimline" components pictured here. All feature brushed aluminium front panels and a presentation of controls which, while adequate, does not seek overtly to impress. At the top is the ST-8011 AM/FM tuner, which gains in simplicity by omitting the usual tuning meters. However, it employs the Technics "Pyrotune" LED pointer, which not only indicates the frequency to which the tuner is set but which serves also as a signal strength and tuning meter. Recommended retail price is $299.*

*Of the matching amplifiers, the SU-8011 (centre) has a power rating of 24W per channel, all normal facilities and controls, and specifications in line with what would expect of a modern design. The recommended retail price is $229.*

*The SU-8022 (bottom) offers 35W to 40W per channel, depending on load, high and low filters, extra tape handling facilities and somewhat tighter specifications in other respects. The recommended retail price leaves the buyer with just 5c change from $300. For further information: G.A. Dawes or B.Barber, National Panasonic (Australia) Pty Ltd, 57-59 Anzac Parade, Kensington 2033.*





significant wow, or flutter, or rumble, or hum injection into the cartridge, it was doing the job expected of it. How could it possibly colour the musical content of a disc?

But, in due course, an awareness dawned that the golden ear boys could be right. It had long been known that hifi systems could suffer from acoustic instability when sound energy from the loudspeakers was able to vibrate the playing deck sufficently. The end result was a loud rumble or howl which could only be stopped by turning down the volume control, or sometimes the bass control.

It was such an obvious and embarrassing problem that the industry sought to minimise it with measures such as resilient mountings, heavy turntables, dynamically balanced playing arms, and so on. Success was deemed to have been achieved if hifi modules could be strung together and used in a typical domestic situation without obvious signs of acoustic feedback.

But there came the realisation that lack of obvious instability might not be the end of the matter. Even though acoustic feedback may have been reduced well below the oscillation level, the phono deck assembly could still be picking up significant sound from the loudspeakers and feeding it back through the system. Was it not likely that this would colour the final sound?

At this point, thinking seems to have gone somewhat askew, influenced possibly by the existance of some very light turntables and others which produced obvious ringing noises when tapped with a finger. After all, the turntable was a large flat disc, suspended only in the centre and coupled intimately to the stylus. Surely it had the potential to behave like the diaphragm of a rudimentary microphone?

Hence the assumption: some turntables are more "musical" than others!

During 1977, a serious attempt was made by "HiFi Choice" magazine to quantify microphonic effects in turntables. In broad terms, the procedure involved connecting the particular player to a hifi system and setting the controls for normal playing. The turntable was then stopped and the stylus left resting in the stationary groove. At the other end of the system, the loudspeakers were disconnected and the output (if any) monitored by means of a meter, CRO or pen recorder.

Sound, at a selected level from a separate loudspeaker was then directed at the record player and swept across the range 20Hz to 2000Hz. By such means it was possible to plot the amount of sound picked up against frequency and to relate it to the signal and sound pressure levels which would be present in the hifi system during normal listening.

The tests pointed clearly to a measureable amount of "breakthrough" by incident sound particulary in the region below about 400Hz. It suggested that, in a typical hifi installation, the playing deck may well "hear" the sound from the loudspeakers and generate a spurious "echo" signal at a level determined by the acoustic path and the nature of the turntable. This was the stuff of which "colouration" was made.

Point demonstrated: there were firm grounds for claiming that some turntables were more musical than others, because they were less sensitive to breakthrough!

More recently, James Moir and William R. Stevens ("Wireless World", May 1979) have done additional work in this field. They have verified the existance of acoustic breakthrough in record players but have shown that it is simplistic to pin all (or even most) of the blame on the actual turntable. It is only one link in a very complex chain.

They found that the table tops or shelves on which record players are conventionally supported invariably exhibit resonant modes. In a typical listening situation, these are excited by energy coupled to them from floors and walls via legs and brackets. Of necessity, evaluation tests, as outlined previously, should be done with the source loudspeaker and the player under test resting on solid concrete.

Again, they found that results were influenced by standing wave modes in the room itself. These had the ability to reinforce or reduce energy at the turntable, thereby further confusing any observations.

To cut a long story short, Moir and Stevens concluded that just about every

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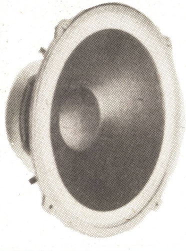

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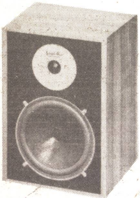
## EXCITING SYSTEMS



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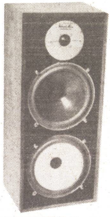

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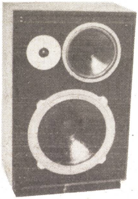

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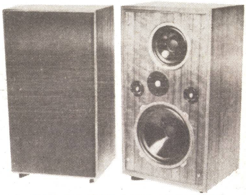

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## HIFI TOPICS — cont.

*Toshiba's new PC-X6AD cassette deck features their "Automatic Dynamic Expansion System" (referred to as "ADRES"). Toshiba say that it operates over the whole audio spectrum and offers a potential signal/noise ration of 75dB, with a potential dynamic range of 85dB. The swishing sound which can occurr with some noise reduction systems with changing gain — often called "breathing effect" — is said to have been reduced below audibility. Retail price of the PC-X6AD is quoted as $539. Toshiba are also offering the ADRES system as a separate unit which can be used in conjunction with other tape and cassette recorders. (Toshiba Aust. Pty Ltd, 16 Mars Rd, Lane Cove, NSW 2066).*

physical element in a typical record player from the framework to the arm (especially the latter) and every physical constant (mass, compliance, resilience, &c) made some contribution to a most complex breakthrough pattern. They were even able to show that closing the perspex lid of a player was able to shield the arm from some of the higher frequency acoustic energy.

They made the point that breakthough could have an affect other than direct colouration. Under high level conditions, where it could build towards an unstable condition (in regions of positive feedback) the exaggerated levels could carry the amplifier closer to overload and hasten the onset of clipping of transient peaks elsewhere in the spectrum.

Summing up, Moir's and Stevens' work confirms the subjective observations about "musical" turntables but shows the original explanation to have been much too simplistic.

For the rest of us, the lesson is clear: don't be content just to achieve formal acoustic stability with controls advanced as far as we are ever likely to want them. See if you can set up the system such that, with the controls advanced and the stylus resting on a stationary disc, tapping the player produces a dull thud rather than a resonant dong!

With that one reasonably under our belt, here's another one to worry about: The May 1979 issue of "Practical HiFi" magazine carries an article on record cleaning gadgetry. Amidst all the talk about the prime job that record cleaners have to do, we were intrigued by the author's remarks about the subjective effect on the sound of brushes which ride the record while it is being played. Not brushes attached to the pickup cartridge, mind you, but brushes attached to entirely separate arms!

One is moved to ask: how on earth can a tiny, dry brush on a separate arm, lightly sweeping the disc and well clear of the stylus . . . how can it possibly affect sound quality?

Quite markedly, according to the magazine in question.

Of one brush the writer says; " the most noticeable degradation of quality concerned some loss of minor detail". This was paralleled by remarks on another brush where the effect on sound quality was said to be "minor with only mild masking of fine detail and ambience".

But, then, a third bush was rated as suffering "some loss of depth in the stereo imagery, but the precision of image placement was retained. Some mild mid-range colouration was noted".

With a fourth brush "some bass impact was lost, stereo imagery was muddled and there was some depth restriction with a minor detail loss".

The fifth was a killer: "woolly bass and a honky and occasionally metallic mid-range. Stereo image placement was spoilt and detail became splashy".

I may be a doubter from way back but I do need convincing about the validity of all this. At the very least, I am tempted to invoke Julian Hirsch's observations about "excesses of hyperbole".

I wonder how a entirely separate brush can change the "ambience" of a recording, ambience being an intrinsic part of the signal.

I am not clear what they mean by "depth of stereo imagery" and how whatever-it-is can be lost if the precision of image placement was retained.

"Honky" and "metallic" mid range worries me; that would signify a quite startling amount of positive feedback in that part of the spectrum — sufficient to boost mid-frequency gain and produce mid-frequency ringing. That's what the opinion would imply.

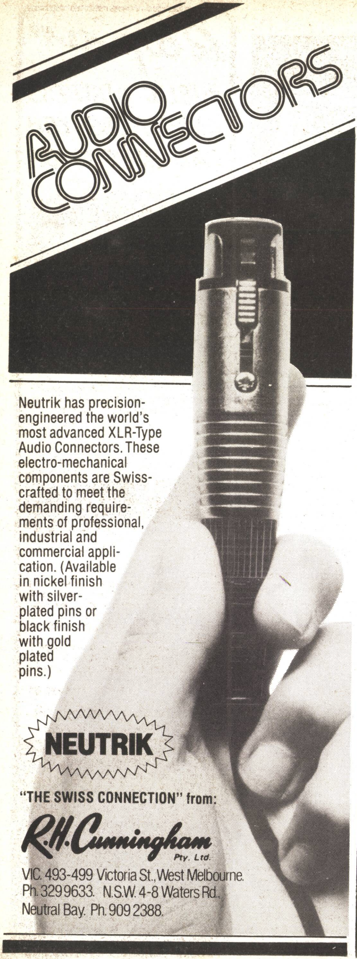
Yet, at the bottom end, the bass is "woolly" or suffers from loss of "impact". Presumably, here, we are up against a negative feedback effect!

Sorry, but I have yet to be convinced that the acoustic fall-out from trailing brushes is of anything like the magnitude that the aforementioned report implies.

Last but not least, I have been intrigued to read reports, in a number of overseas magazines, about a new Carver C-4000 preamplifier featuring "sonic holography". Like many such

## Staff appointments at 3M Australia

*To cope with increasing response to their "Scotch" brand tapes, 3M Aust. Pty Ltd announce that Mr. Peter Rose (left) will be Marketing Director for the Audio/Video Products Division of the company. Mr. Graham McCredie, (right) who has also been with 3M for many years, will occupy the position of Market Development Manager for the Division, at 950 Pacific Highway, Pymble, NSW 2073.*



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## HIFI TOPICS — continued

terms, "sonic holography" tended to put me right off, on the grounds that it seemed much more fanciful than factual.

That initial bias notwithstanding, I went on the read that the preamplifier included circuitry which could seemingly project the sound sideways beyond the actual loudspeakers and also forward in space towards the listener. It could produce a surround sound effect from many ordinary stereo records with just the two frontal speakers in operation. Listeners found it hard to accept that other loudspeakers around the room were disconnected.

One might have written this down, along with the name, as being yet another elaborate sales spiel. However, I remembered a listening experience in an anechoic chamber at Matsushita in Osaka Japan — reported in these columns in the March 1978 issue.

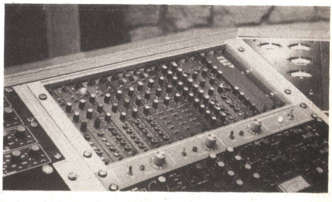
On that occasion, I was invited to sit on a chair at the apex of a triangle based on two conventional stereo loudspeakers. To my amazement, I heard reproduced voices whispering first in one ear, then the other, and from just behind my head. It was an exact duplication of the sensation one gets when listening to a binaural demonstration record through headphones.

Before the demonstration, if you had asked me whether such a thing was possible, I would have retorted with an emphatic "no".

I gather that it relied on very precise cancellation effects to ensure that each ear was conscious only of the sound from its corresponding loudspeaker — as for headphone listening. In a normal stereo situation, both ears hear signals from both loudspeakers and this tends to establish the line out front, along which the sound sources are dispersed.

In Matsushita's anechoic chamber, the right ear heard the right-hand loudspeaker as normal. It was also capable of hearing the sound from the left-hand speaker, but very slightly delayed in time because of the extra path length around the head. Presumably what Matusushita engineers were doing was to take some of the left-hand signal, delay it by precisely the same interval in a bucket-brigade device, then reverse it in phase, than feed it through the right-hand amplifier.

## FROM THE LONDON SCENE:



*This "SCAMP" rack and power supply has just been installed in the new Town House Studio complex in Shepherds Bush, London. It carries (left to right) two SO1 compressor/limiters, two SO5 and two SO6 dynamic noise filter gates, three F300 expander gates, two SO7 octave equalisers, two S23 pan effects modules, one S24 time shape module and one S14 LED column Space remains for two possible additional modules, an S100 dual gate and/or an SO2 mic preamp. All this equipment is supplied by Audio & Design (Recording) Ltd, who are specialists in sophisticated audio recording equipment. Their sales and marketing Division is at 84 Oxford Rd, Reading RG1 7LJ, England. Tel: Reading (0734) 53411. Telex: 847605 a/b Tillex G.*

# Music while he (the dentist) works!

*Bell & Howell Australia Pty Ltd, are already active in many fields, including business equipment, education, audio visual, electronics, instrumentation and photographics. They have now opened a new division, under system designer Neil Smith, to market a unit called "Trideck". It will accomodate three cassettes and can play both sides without interruption, to provide uninterrupted stereo music for many situations including dental surgeries. Provision is made for microphone interruption over the background. To display the equipment, the company is equipping a mobile sound lounge. (Bell & Howell Aust Pty Ltd, Sound Systems Division, Audio-Visual Communications Group, GPO Box 4778, Sydney 2001).*

At the right ear, this delayed out-of-phase signal would exactly cancel the direct left-hand signal, leaving the right-hand signal as the only one audible to the right ear. Similarly, the left hand ear was made to hear only the left-hand speaker. With each speaker heard through only one ear, the sources could no longer be pinpointed and the conditions for conventional binaural listening were satisfied.

While testifying to the effectiveness of the demonstration, I did speculate as to whether the same sensation could be approximated under normal domestic listening conditions.

In the same report I referred also to other demonstrations involving bucket-brigade devices (BBDs) in which Matsushita engineers were able to show enhanced spread and surround, both with headphones and loudspeakers.

Reading the reports on the new Carver preamplifier, it seemed abundantly clear that the designer was exploiting similar techniques — and incidentally answering my speculation about their effectiveness in normal listening environments. Having listened to demonstrations, overseas writers were unanimous that the forward projection of the sound (approaching the binaural condition) was highly dependant on the listening situation, and that it ranged from startling to barely noticeable.

However, when backed up by other measures to spread the apparent sound source and even drive additional and optional "surround" loudspeakers, the Carver was not short of dramatic effects.

But "sonic holography"? I suppose it's okay as marketing term — as long as you don't take it too seriously!

**FREEDMAN ELECTRONICS Pty Ltd,** of 89-91A Liverpool Rd, Summer Hill, NSW 2130 are sole Australian distributors of Dynacord brand products. The Dynacord company, located in Straubing, W. Germany, is a leading manufacturer of "orchestra" electronics, discotheque components and public address equipment. Dynacord was prominent in the XX Olympic Games in Munich, in 1972, as the company in charge of all sound equipment in the Theatron, all discotheques, the press centre, &c. Dynacord has now been named as the "Official supplier of the XXII Olympic Games in Moscow" for 1980. A feature of the facilities in the Moscow olympic village will be a "phonotheque" where inhabitants of the village will be able to listen selectively to a wide range of programs by headphone. The discotheque will be along more conventional lines, with top quality equipment and a multichannel light display.

**PIONEER ELECTRONICS AUST PTY LTD** are offering a turntable which should never need to be "up-graded" Designated as type PL-560, it is a push-button operated, fully automatic, direct-drive model with a quartz/PLL servo controlled Hall motor giving high torque. A second motor operates the automatic functions. The platter is 32mm high and about 25mm larger in diameter than most, its "flywheel" effect contributing to a very low wow and flutter figure of 0.025% (RMS), and a noise figure of better than -73dB. Pioneer say that the PL-560 should logically be mated with their PC-600 moving magnet cartridge, having a response from 10Hz to 42kHz. Price of the PL-560, excluding cartridge, is $559. (Pioneer Electronics Australia Pty Ltd, 178-184 Boundary Rd, Braeside, Vic. 3195. Tel. 03 90 9011).

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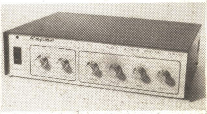

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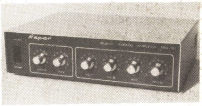

**MODEL TPA 70**

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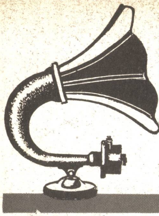


# AUDIO TALK

**by LEO SIMPSON**

## LOUDNESS CONTROLS

Some years ago now, in July 1974, I wrote a short article on the subject of Loudness controls on amplifiers. As might be expected, the article was not in favour of these controls. The reason for returning to the subject is not that I have changed my opinion, but that we now have a whole new bunch of readers who have not yet developed the right attitude towards Loudness controls. Indeed, many people even believe that the Loudness control should be used!

Well let's start out objectively and discuss what Loudness controls do. Then we can perhaps define what they should do, which will lead us to see why they can't.

The idea behind the Loudness control is that it is supposed to compensate for hearing losses at low sound levels. It is well known that the sensitivity of human ears is reduced at low and high frequencies when the sound level is low. This was first documented in 1933 by Fletcher and Munson, who produced a graph of "equal loudness contours". We have reproduced a later version of these curves, to illustrate the effect.

What the equal loudness contours show is the typical frequency response of the human ear at various sound levels. The first thing that is apparent from these curves is that nowhere within the range of bearable sound pressure levels is the human ear frequency response actually flat. At very intense sound levels, for example, the curves show that the response of the ear has a pronounced peak in the region of 3 to 4kHz, of about 15dB.

At lower sound levels we see that the 3 to 4kHz peak is less pronounced but the response at frequencies below about 200Hz becomes markedly reduced. To a lesser extent, the high frequency response of the ear is also reduced at low sound levels.

To compensate for this effect, amplifier designers have given us the Loudness control. This is usually arranged to provide about 10dB of boost at 100Hz and, on some of the more pretentious amplifiers, about 6dB of boost at around 10kHz; midrange frequencies are held at reference.

This degree of boost is usually based on the "equal loudness contour" level of about 30 phons. Just as an aside, the phon is a logarithmic measure of subjective loudness level.

The other premise which is used to justify the loudness control is that, in the normal home listening situation, listeners are often force to keep the volume down out of consideration for other members of the household. In this situation, the reproduction is supposed to be effectively lacking in bass and extreme treble, in comparison with "normal" sound levels.

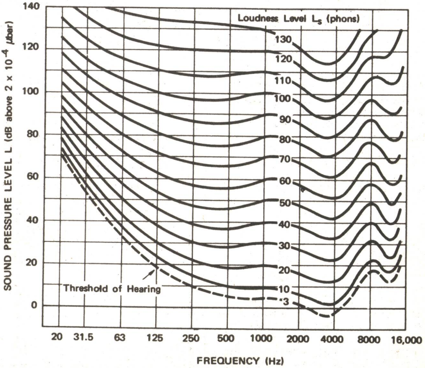
Well let us accept, for the moment, that the amount of boost provided by the typical loudness control is at least a partial compensation for the low level characteristics of the ear. Now in most amplifiers with a loudness facility, the boost is applied at low settings of the volume control and is gradually reduced to zero as the volume control is advanced to the 12 o'clock setting.

But the logic begins to fall down at this point because, with typical cartridges and records, most amplifiers will deliver maximum power with the volume control set to 12 o'clock or less. This is partly because many amplifiers are over-sensitive and partly because their volume control characteristic is too rapid in the first half.

Whatever the reason, most amplifiers are quite loud even at the quarter-on setting of the volume control; yet the loudness facility is applying bass and maybe treble boost, to compensate for supposed hearing losses which are apparent at much lower sound levels.

The real problem is that the designer cannot predict just how loud the system will be at a particular volume control setting; the actual loudness will depend on the signal source, type of music being played, the loudspeakers and the listening room. But even if the designer could predict how loud the system would be at a given control setting, the fixed loudness compensation approach makes no allowances for the dynamic range of the material to which you are listening.

So if the listener is playing a record with wide dynamic range, he will be forced to set the volume control at a low setting in order to accommodate that wide dynamic range; otherwise, if the volume control was advanced, the amplifier or the loudspeakers would overload on signal peaks. If the listener elects to use the loudness facility in this



*These curves relate human ear frequency response to sound pressure level.*

situation, he will be applying bass and treble boost at all times, even on the very loud peaks, where it is quite inappropriate.

I should mention at this stage, that some designers have attempted to overcome the problem of not being able to predict the system loudness. They do this by providing two controls instead of the single volume-cum-loudness control. Typically one control will be labelled "Master Volume", while the other is labelled "Contour" or something similar.

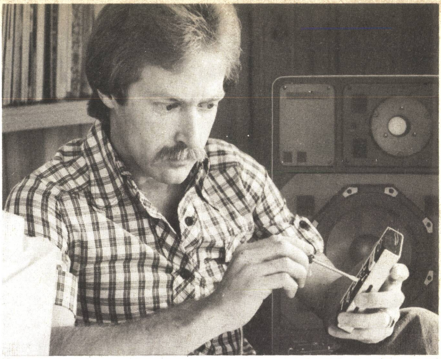
The idea with this arrangement is that you initially set the Contour control fully clockwise and then advance the Master control to the loudest level that you will normally wish to use. From then on you use the Contour control and it varies the amount of boost applied, dependant on its setting. This and other variations on the Loudness theme are at least a step in the right direction, but they fail to take account of the dynamic range of the program.

Really, the only method by which an audio system could be precisely compensated to suit the hearing characteristic of a given listener would be to have a dynamic feedback system whereby the overall sound level was monitored and the bass and treble boost varied accordingly. The resulting compensation would vary from moment to moment, according to the dynamic range of the program.

You would need a computer programmed with the full hearing characteristic of the listener, to do the job properly. Who knows, maybe some keen microprocessor nut is working on just such a scheme right now! But even the most brilliant programmer would be baffled by the problem of providing loudness compensation to suit two or more listeners at the one time. Each listener has a different hearing characteristic, which can vary markedly from the average curves produced by Fletcher and Munson. (Even your own two ears are not identical).

Really, the loudness facility found on most amplifiers functions mainly as a preset bass boost control. But, as such, it tends to apply a fair amount of boost at the upper bass frequencies around 400Hz and this tends to "muddy up" the sound. If that's not bad enough, many users apply boost with the tone controls too. Some even use the Loudness control when listening at quite high levels with headphones.

Some may say that if the listeners enjoy it, well that's that. But the end result is not high fidelity sound. Why spend a lot of money on a high performance audio system and then spoil it by using the Loudness facility? As far as I am concerned, the best feature of the Loudness facility on an amplifier is the switch to disable it.



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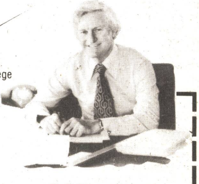

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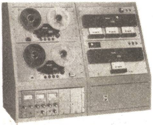

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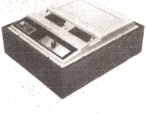

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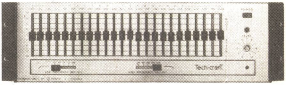

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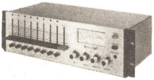

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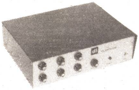

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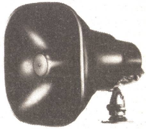

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# Audiosound 8033 Minuet

**Based on the highly successful Minuet 3, the new Audiosound Minuet 8033 is a carefully designed two-way system with a 150mm bass driver and 25mm dome tweeter plus a complex crossover network having no less than twelve elements.**

In these times when many loudspeaker systems are look-alikes and some are quite odd, it is unusual to come across a system which looks like an attractive piece of cabinetry. Even more unusual is the fact that this system is made in Australia by one of few remaining manufacturers of audio equipment, Audiosound Electronic Services.

As far as size goes, the new Audiosound Minuet 8033 is middle-of-the-road. It will fit on most shelves, but is not too small to be used as a floor-standing unit. Dimensions are 331 x 562 x 312mm (W x H x D), which includes the detachable kickboard.

The cabinet is made of chipboard with a synthetic veneer on all surfaces. The front edges of the cabinet are bevelled, and are matched by the bevel on the removable grille cloth frame. The logo and type number are screen-printed onto a black-anodised aluminium extrusion which is flush-mounted with the front edge of the cabinet.

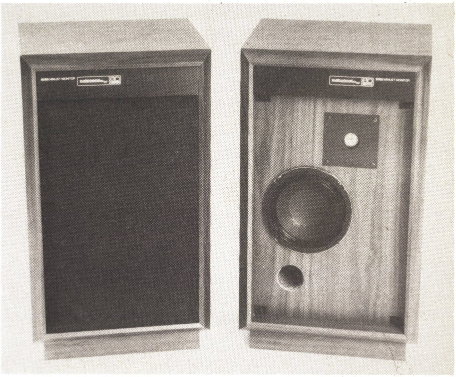
Removing the grille cloth frame reveals two speakers and a small tunnel on a relatively large baffle. It is here that the Audiosound Minuet differs markedly from the design approach of many Japanese loudspeakers. Instead of cramming the largest possible woofer and perhaps two or three other drivers into the enclosure, Audiosound have critically matched a 150mm woofer to a reasonably large enclosure, using the procedures pioneered by Neville Thiele and Richard Small.

The tweeter is a well-known 25mm dome unit which has been modified by Audiosound to improve its propagation characteristics.

Coupling the two drivers is a complex crossover network, which uses a total of twelve elements including polyester capacitors and air-cored coils. Both the woofer and tweeter have parallel impedance equalising networks, and the tweeter has a series attenuator to match it to the woofer. The woofer is coupled via a 6dB/octave network, while the tweeter is coupled via an 18dB/octave Butterworth filter. Crossover frequency is 3kHz.

On the rear panel is a cut-out for a pair of spring-loaded terminals. There is also an adhesive panel which carries the specifications.

Audiosound quote the overall free-field frequency response of the Minuet 8033 as 40Hz to 20kHz within ±5dB. Our tests indicate that the steady state response is indeed very smooth and well-maintained, from just below 40Hz to beyond the upper limit of audibility.



The impedance modulus curve is also reasonably smooth, with a minimum of 5 ohms at 20kHz and a slightly higher figure at 2.3kHz. At the bass end, there are peaks of 23 ohms at 65Hz and 17.6 ohms at 30Hz, with an interposed dip at 40Hz of 12 ohms.

On music, the Minuet 8033 is very impressive. The bass response is remarkably smooth and well-maintained, with no need to apply supplementary bass boost. There is perhaps a slight tendency to colouration of the upper bass register which is possibly due to the effect of the small port. However, this effect is second-order — the overall bass response is comparable with much more expensive loudspeaker systems.

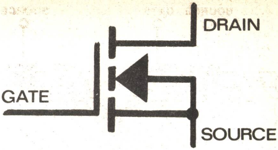
The midrange is very smooth and apparently free from phase-nonlinearities. At the high end, we think the tweeter is a little over-dominant as it has a tendency to emphasise disc surface noise — a touch of the treble control is needed to correct this. But overall reproduction is of a very high standard.

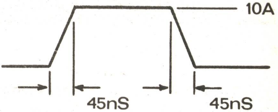
Our overall conclusion then, is very favourable. Audiosound seem to have got it all together with the Minuet 8033 — it is well finished with pleasant styling and with a sound quality that is impressive. Even the price is attractive. At $328 a pair, they represent good value for money.

Audiosound also have available an accessory stand which raises the enclosure off the floor by 25cm, for cleaner bass reproduction. These stands are available at $28 a pair.

Further information and demonstration of Audiosound equipment is available from Audiosound Electronic Services, 148 Pitt Road, North Curl Curl, NSW 2099. (L.D.S.)

# VFETs — power device of the future





**A power transistor that can switch 10 amps on or off in less than 50 nanoseconds, or can act as a linear power amplifier with a transconductance of 2 amps per volt — impossible? Not at all. They're called VFETs and you can buy them now in Australia at reasonable prices. As this article explains, they're the closest thing yet to a perfect power control device.**

### by LEO SIMPSON

As long ago as May 1975, "Electronics Australia" ran an article on the commercial use of VFETs in prestige Japanese stereo amplifiers. Now, just over four years later, VFETs are becoming readily available at a reasonable price. Even now, the more rugged VFETs are still relatively highly priced, although prices look set to decline with increasing use.

An examination of VFET parameters indicates that they offer considerable advantages over equivalent bipolar transistors. Indeed, unless bipolar transistor technology is able to make great improvements in the near future, VFETs and similar FET devices may, completely supplant bipolar power transistors.

The particular range of VFETs which have just become available in Australia is made by Siliconix Incorporated, USA. This company has done much of the pioneering work in this new field of power devices. Elsewhere in this issue we feature our first circuit using VFETs.

Siliconix term their devices "VMOS Power FETs". They are N-channel, enhancement-mode devices. The latter term means that their control characteristics are similar to enhancement-mode or type C MOSFETs. Let us have a look at their structure, which is shown in cross-section in Fig. 1.

VFETs are fabricated from N-type epitaxial wafers, with the epitaxial layer much more lightly doped than the bulk of the wafer. Into the epitaxial layer are first diffused lightly-doped P-type islands, which ultimately form the channel regions. Then, smaller but heavily-doped N-type islands are diffused into the centres of the P-type islands to form the source regions. Below these island regions the heavily-doped N-type substrate and epitaxial layer become the drain regions.

A V-shaped groove is then etched out of the centre of each of the concentric islands, down through the source and channel regions and into the epitaxial layer. Oxide passivation is then grown in the grooves and on the wafer surface. Aluminium metallisation is then deposited on the surface to form the source connections, and in the groove to make the gate electrode and connections. Finally, the wafers are given a further passivation to prevent contamination of the gate oxide.

The resulting geometry is quite different from the closest relation of the VFET, the enhancement-mode MOSFET. This latter device has a horizontal structure.

The vertical structure of VFETs provide several important advantages over conventional mosfets. The length of the channels is determined by diffusion depths, rather than by masking,; this gives a better width to length ratio and allows higher current densities to be obtained.

Each V-groove creates two parallel channels, so that current density is inherently doubled anyway. And as the substrate forms the drain contact, no drain connection is needed at the top of the chip. This further reduces the chip area required for a given device current rating, and keeps saturation resistance low.

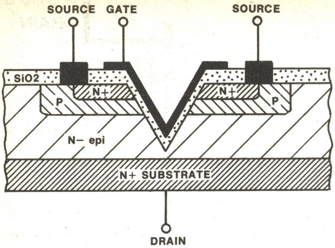
Since the gate only overlaps the drain at the bottom of the V-groove, gate-drain feedback capacitance is relatively low compared with a conventional MOSFET. The epitaxial layer of the VFET device absorbs the depletion layer of the reverse-biased junction between the channel region and drain region. This gives the VFET a relatively high breakdown voltage — as high as 90V for some devices.

Well, that explains some of the difference between VFETs and Conventional MOSFETS; but what is the meaning of the of the term "enhancement mode"? This is a term which originally applied to junction FETs when operated with a slightly positive gate-source voltage (for an N-channel device) which results in higher or "enhanced" drain current. But this enhancement is severely limited in a JFET because the gate-source voltage must be kept below the value of about 0.6V, above which gate current begins to flow.

By contrast, in a MOSFET (and VFET) the gate is insulated, so it is possible to operate with reasonably large values of positive gate voltage to obtain "enhanced" drain current.

One important characteristic of "enhancement mode" MOSFETs results from their construction. Unlike "depletion-mode" FETs (which mode is fully described in our handbook "Fundamentals of Solid State") the "enhancement mode" FET has no physical channel linking the source and drain "islands". What actually happens is that the "forward" bias applied to th gate creates an induced channel.

So without any gate bias there is no induced channel and no current flows between drain and source. In other



**CROSS SECTION OF A VMOS TRANSISTOR**

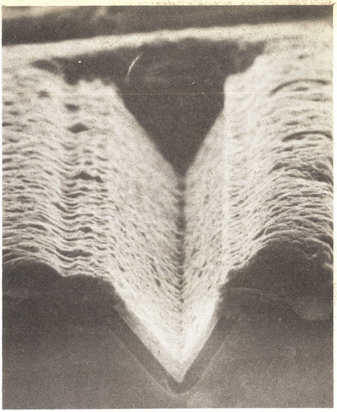


*Fig. 1 above shows the construction of a VMOS power transistor (VFET). At right is a scanning electron microscope view of the V-shaped groove in a VFET.*

words while conventional JFETs and depletion-mode MOSFETs will conduct with no gate bias applied and are regarded as "normally on" devices, enhancement-mode devices such as the VFET are "normally off".

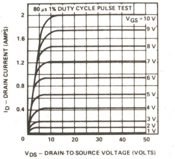
The gain of FETs is defined in terms of transconductance or mutual conductance, which is usually symbolised as gm. This is expressed in milliamps per volt. VFETs have very high transconductance figures — typically 100 to 250mA/V. Compare that with the equivalent figures for typical JFETs — 1 to 8mA/V. The VFET really is a high gain voltage-controlled power device.

Fig. 2 shows the output characteristics of the VN66AF (which is a lower voltage version of the VN88AF). The transconductance is essentially constant above 400 millamps drain current. Fig. 3 is a more graphic illustration of the linearity of the transconductance vs drain current (above 400mA).

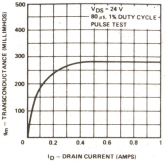
This essential linearity of VFETs shows great promise for audio amplifiers, in that it should allow a low distortion amplifier to be designed with a relatively simple circuit and a modest order of negative feedback.

The most rugged VFET currently in the Siliconix range, the VN64G, is an 80W (60V, 12.5A) device with a transconductance figure of typically 2.2 amps per volt. Wow!

All the VFETs in the Siliconix range, apart from those intended for RF power applications, have internal zener diode protection of th gate. This does have the effect of reducing the extremely high input impedance which is obtainable with MOSFETs, but the effective input impedance is still very high, typically 1000 megohms. As such, the effective current gain of a typical VFET is more than 1000 million.



**Output Characteristics of the VN66AF**



**Transconductance vs Drain Current of the VN66AF**

*Fig. 2 (top) and Fig. 3 (by courtesy of Siliconix Incorporated).*

Because of its high gain-high impedance characteristic, a VFET can be directly interfaced to CMOS logic circuits or opto-isolators. That is certainly not the case with bipolar power transistors.

In other comparisons also the bipolar transistor suffers. Consider switching speed for example:

A typical VFET such as the VN88AF in circuit published elsewhere in this magazine is capable of switching 1 amp on or off in less than 4 nano seconds. Depending on the actual comparison, this is about 10 to 200 times faster than a bipolar transistor.

Similarly, a typical VFET intended for RF amplifier applications is capable of delivering 20 watts at 150MHz with an input power of only 1 watt. The reason for this superior switching and RF amplifier performance is that VFETs are majority carrier devices and they also use high-mobility electrons rather than holes as carriers. (For elucidation of these terms, see "Fundamentals of Solid State".)

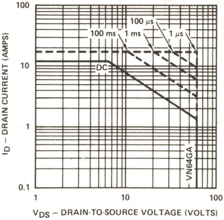
Other advantages of VFETs are inherent thermal stability and the ability to share current evenly both within a single device and between parallel devices. Since the transconductance of FETs reduces with increasing temperature, they tend to draw less current as the temperature rises. Bipolar transistors are inherently unstable because their current gain rises and forward-biased junction (base-emitter) voltage drop reduces with rising temperature.

So, if a VFET tends to overheat it tends to throttle itself back to reduce the power dissipation. This does not mean that they can be abused by operating with minimal heatsinks and high chip temperatures — that would cause long term damage and ultimate failure. But unlike bipolar transistors, VFETs do not "run away".

As far as the VFET is concerned, its inherent thermal stability means that circuit configurations can be made simpler. For example, in a class-B audio amplifier, a VFET configuration would probably require little in the way of quiescent current stabilisation circuitry.

Freedom from current crowding and localised "hot spots" on the VFET chip means that it is not subject to secondary breakdown, as are bipolar transistors. This is illustrated clearly in Fig. 4 which shows the "Safe Operating Area" for the VN64GA referred to earlier. The solid sloping line represents the 80 watt maximum dissipation of the device (if drawn on linear scales, this line would appear as a hyperbola). Notice that the VFET can dissipate its full 80-watt rating right up to its maximum voltage rating of 60V.

By comparison, consider the bipolar transistor BD140 which is an 80V device with a maximum dissipation of 8 watts. Up to a collector voltage of about 13 volts, the BD140 can dissipate its full rating of 8W. Above this voltage, the effects of second-breakdown make it necessary to derate the device. At its maximum collector voltage of 80V, the BD140 can only conduct 40 milliamps. This amounts to a dissipation of only 3.2 watts.



*No de-rating of VFETS is required to allow for secondary breakdown effects.*

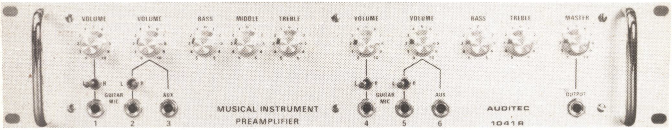
All the foregoing may lead the reader to believe that the VFET has it all over the bipolar transistor in every respect. However, there is at least one parameter in which the bipolar transistor is clearly superior to the VFET — saturation voltage. Whereas a typical bipolar power tansistor has a collector saturation voltage of 0.2V or even less, the equivalent figure for a VFET, at a drain current of several amps, is of the order of 3 or 4 volts!

This needs to be considered in high power inverter design. Whereas the VFET has the advantage of very fast switching speeds and minimal drive power, which leads to high inverter efficiency, its own switching losses are a major factor. The bipolar transistor has very low switching losses but its drive power requirements are high and increase markedly at higher switching speeds.

Perhaps the biggest problem with VFETs at the moment does not lie with the devices themselves but in the thinking of most designers. Since they are voltage-controlled devices, they require a very different approach from that applied to bipolar transistors.

Clearly then, while the VFET may not be the perfect answer to every power semiconductor requirement, it certainly is a very promising device which will result in very high performance circuitry once designers learn how to use them to best advantage. And if the device makers can reduce that saturation voltage, we will have near-perfect power control devices!

FOR THE PROFESSIONAL



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## A practical approach to electronics — 4

# Zener Tester

How do you identify zener diodes when their markings rub off? How do you distinguish them from ordinary diodes, and also work out which lead is which? The little tester presented here solves these familiar problems neatly, and also lets you check the breakdown voltage of transistors and normal diodes without damage. It also happens to be our first project using the new VMOS power transistors.

by **LEO SIMPSON**

At some time or other, everyone who is involved in electonics has come up against the problem of miniature zener diodes. They are so small that the minuscule printing on their body is difficult enough to decipher at the best of times. But you only have to handle them once or twice and the printing becomes completely obliterated.

The problem is bad enough when only one zener is used in the circuit you are constructing but when several are involved you just cannot proceed until they are all identified. If only one zener diode is involved, you may solve the problem fairly simply. If you purchased it this morning (and the printing is already rubbed off) then you can identify positive and negative leads by using the low "Ohms" range of your multimeter.

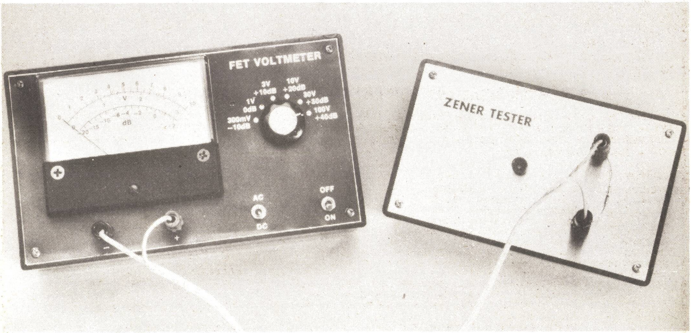
This presupposes that you know, without any doubt, that the zener dioded in question was the correct value. With this knowledge you can confidently install the zener in circuit and be sure it will work. However, to be able to use a multimeter to determine diode polarity, you need to know which probe is positive when the unit is switched to the "Ohms" range.

Usually, but not always, the probe polarity of a multimeter is reversed when used on the "Ohms" range. You can check this by testing it with another multimeter (ON A LOW "Volts DC" range) or by using an ordinary diode on which the polarity marking is clear. On most diodes, the cathode lead is identified by a stripe at the cathode end of the body.

While a multimeter may give polarity identification of a zener diode it is of little use in identifying the reverse breakdown voltage. To do this, you need some sort of constant current source. In practice, this takes the form of a high voltage DC supply together with a series limiting resistor, to protect both the supply and the zener diode to be tested.

The method of test is simple: Connect the zener diode across the high voltage DC supply together with a suitable current limiting resistor, to prevent over-dissipation in the zener. Then use a multimeter switched to an appropiate DC voltage range to measure the zener voltage. Or you could make up a composite instrument, with built-in voltmeter.

In its simplest form, a suitable a high voltage supply could be realised with a small mains transformer having a secondary winding of 150 volts or so. Couple this to a half-wave rectifier and filter capacitor and it will provide about 200 volts DC, which is more than adequate for the purpose. Many hobbyists will have a suitable transformer in their stock of oddments but for those who don't, such a transformer is expensive



*You can readily identify those small zener diodes with our new Zener Tester, and also check breakdown voltages of transistors.*

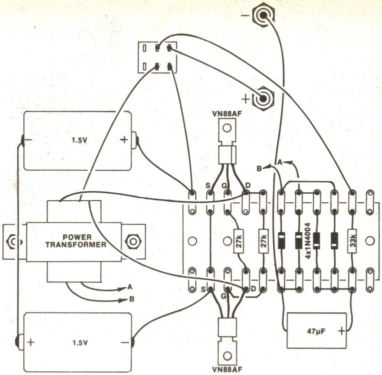
and not readily available over the counter.

With the above difficulty in mind, we set about producing a high voltage supply using cheaper and more readily available components. Our approach was to develop a low power transistor inverter using a small readily available mains transformer with a centre-tapped 12.6V winding. The transformer is used back-to-front, ie., a low voltage waveform is applied to the "secondary" and stepped up in the "primary".

We estimate that the current cost of this zener tester is approximately

**$18**

This includes sales tax.



*Even without a PCB, this circuit is easy to assemble. You could have it going in an hour.*

This is acheived by connecting a transistor multivibrator across the low voltage winding. The square waveform produced by the switching action of the transistors is multiplied approximately 20 times by the transformer, to appear as high amplitude waveform across th 240V winding. This can be rectified to produce high voltage DC.

In the past, we have used bipolar transistors for this sort of application but since VMOS FETs have just recently become available at reasonable prices, we deicded to use those instead. They are ideal for the jobs as they are particularly suited to switching applications and are not subject to thermal runaway or secondary breakdown.

Using these VMOS devices, the inverter circuit could hardly be more simple. Just two VFETs, two resistors and the transformer are all that is needed. The resistors are not necessary to provide current limiting to the VFET gates, as would be required in the base of an equivalent bipolar transistor circuit; Since they are an insulated gate device, VFETs do not draw any gate current as such.

Instead, the 27k resistors provide current limiting for the internal protective zener diode connected between gate and source of each VFET. The zeners are there to prevent voltage breakdown of the VFET gates due to excessive positive or negative voltage. Each zener prevents its gate from being pulled more than 15 volts positive or 0.6 volts negative.

Despite the apparent simplicity of this particular type of inverter circuit, its operation actually seems to be quite complex. In fact after a lengthy and at times rather animated discussion among the EA staff, we came to the conclusion that we didn't really understand exactly how it does work.

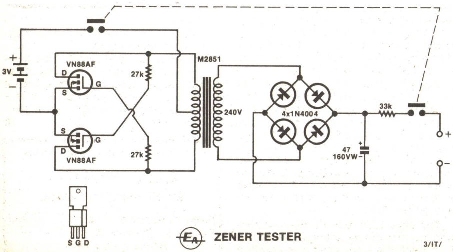
It is one of those "variant" circuits which superficially seems only slightly different from a more familiar configuration, whose detailed operation is quite easy to follow. yet the more closely you look at the "variant" circuit, the more it becomes apparent that it does not work in the same way at all!

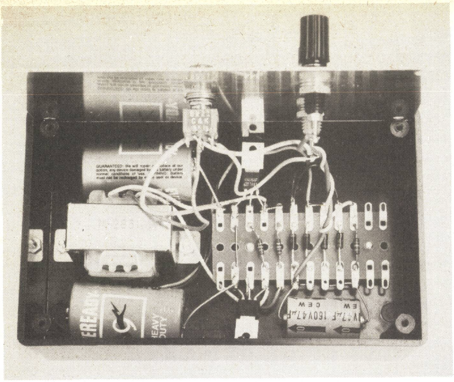
For the moment, therefore, you'll just have to take my word for it that the circuit does work. In fact it oscillates very strongly and reliably indeed — even though we're at rather a loss to explain precisely why and how.

As soon as power is applied, the two VFETs begin a vigorous flip-flop action, with each device alternately driven between cutoff and saturation. As a result the transformer winding has current flowing alternately in one half and then the other, in opposite directions.

The frequency at which this flip-flop action takes place depends on the resistance and inductance on the transformer winding , the reflected secondary load, the output impedance of the low voltage source, and possibly stray capacitance. With the transformer specified; the frequency of oscillation ranges from about 30Hz up several kilohertz, depending on the load on the secondary.

*The circuit below operates very reliably, but it is not as simple in operation as it looks.*





*We used miniature tagboard instead of a PCB to keep the cost down.*

When rectified and filtered, the output of the high voltage winding produces a litttle over 100 volts DC, with no load connected.

We wished to test all the commonly available zener diodes up to 75V. Zener diodes below 30V are usually tested at 5mA, while those above and up to 75V are tested at 2mA. To satisfy those conditions with this circuit requires a battery input voltage of 4.5 of 6 volts at quite a heavy current drain.

To obtain a more modest current drain we decided to use a battery input voltage of 3 volts. This results in an open-circuit voltage of just over 100V, as noted before. With a 33k current limiting resistor, the maximum current into a short circuit (and thus into low voltage zener diodes) is 2 milliamps. For a 50V zener diode the current is reduced to about 1 milliamp, reducing to about 0.5mA for a 75V zener.

Because these currents are lower than the standard test currents for most zeners, the voltage registered will be slightly below the actual or nominal breakdown voltage of the zener. Even so, the voltage registered will be within 10% of the nominal value (assuming a 5% zener tolerance), which is close enough for this purpose.

Current drain is about 90 milliamps from the 3V supply with no load and about 150 milliamps with the output shorted. This order of current can be comfortably provided by C-size cells for short periods, or by a 3V plugpack of the type normally intended for running a calculator.

Efficiency of the circuit is about 45% when the maximum current of 2 milliamps is being drawn from the output terminals. Most of the losses are due to the transformer but an appreciable portion is due to losses in the VFETs. The reason for this is that while VFETs are very effective as switches and do not require much drive power, they have quite high saturation voltage compared with bipolar transistors.

The zener tester realised with this circuit is very easy to use. Just connect a multimeter to the output terminals and switch to the 100V DC range. Connect the zener across the terminals as well, and push the button. The meter pointer should rise up the scale to indicate the zener's voltage. If the reading is low, switch down a range or two to get a reading as close as possible to full-scale deflection.

If the reading is only about 0.6V then you have the zener connected the wrong way around. If the reading is zero, then the device is short-circuit. It takes only a moment to take a reading. When you release the push-button the reading will drop to zero, as the switch disconnects the high voltage source, to avoid the possibility of shock.

Construction of the device is straightforward and should present few problems. The tester is housed in a plastic utility box with aluminium lid. We have not used a PC board. Instead, the total of only ten components is soldered to a length o miniature tagboard. While this may look like more work, it involves very little in extra soldering and saves a dollar or two on two on the PCB.

The only fiddly part of the construction involves the mounting of the two C-size cells. We were unable to obtain a battery holder for these, so they are wired directly into circuit. The two cells are wired in series with a piece of 18-gauge tinned copper wire, which is sleeved with spaghetti and held in place under the transformer core — this provides positive location of the batteries, on either side of the transformer. The remaining battery electrodes are soldered by a short length of tinned copper wire, to the tagboard.

If you have a 3V plugpack in your possession you can dispense with batteries and install a suitable power socket instead.

Since this unit has a low testing current it may also be used to check the voltage ratings of normal diodes; also bipolar transistors (ie., Vcbo and Vceo). The method of test is the same as for zeners, with the emitter or base left unconnected as required.

Considering the low cost of the transformer and the relative simplicity of the circuit, we are sure that many will want to build this handy little tester. It is a neat and practical solution to a common problem.

## PARTS LIST

*1 plastic case with aluminium lid, 160 x 50 x 96mm*
*2 binding post terminals, one red, one black*
*1 momentary contact push-button switch with normally-off DPST or DPDT contacts*
*1 miniature power transformer with 12.6 VAC winding: A&R 6474, Ferguson 2851 or DSE M-2851.*
*1 12-lug length of miniature tagboard*
*2 VN88AF VFETs (Siliconix)*
*4 1N4004 silicon diodes*
*1 47uF/160VW electrolytic capacitor*
*1 33k/¼W resistor*
*1 27k/¼W resistors*
*2 C-size 1.5V cells*
*Hook-up wire, screws, nuts, lockwashers, tinned copper wire, spaghetti sleeving solder, multimeter.*

*NOTE Passive components with higher ratings may be used if space permits. Siliconix VFETs are distributed by IRH Components, Natronics Pty Ltd, 2 The Crescent, Kingsgrove, NSW 2208.*

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# Fully protected dual power supply

**This new dual power supply uses only a few ICs but provides accurately matched output voltages from ±5V to ±15V and currents up to 1.5A. The supply has excellent regulation characteristics and the outputs are protected against short circuits and thermal overloads.**

**by RON de JONG**

Perhaps the most often used piece of test equipment on the enthusiast's bench is the regulated power supply, and we've certainly described quite a few of them to date. These supplies offered a wide range of voltage and current capabilities, but most were of the single supply variety. None provided a split supply with the simplicity of this design.

A split power supply is very desirable when experimenting with op-amp circuits. The low price and excellent performance of modern op-amps makes them very suitable for everything for amplifiers, filters and oscillators to exotic function generators, so the usefulness of a split supply such as the one described here is quite apparent.

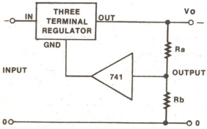


FIG. 1

*This diagram shows how a negative three terminal regulator can be used as an adjustable power supply.*

And if the versatility of a split supply can be obtained for little more than the expense of an ordinary single supply, then all the better. This design certainly achieves that objective. It uses only four inexpensive ICs yet provides performance comparable to that obtained from much more complicated discrete designs.

The output voltage is continuously variable between ±5 and ±15, which is the usual operating voltage range of op-amps. The maximum supply current available is a function of the supply voltage, as can be seen by referring to the accompanying graph. It is a maximum of 1.5A at output voltages up to 12V, then falls steadily to 1A at 15V because of the reduced voltage available from the rectifier at high load currents.

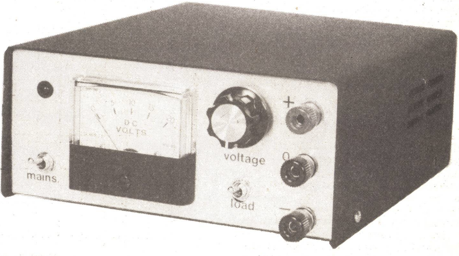
Regulation of the supply output voltage is excellent within these limits, as can be seen from the voltage regulation curves obtained from our prototype. With a load current of 1.2A for example, the positive supply voltage drops only 30mV and that represents a change of only 0.3%.

At the heart of the regulation circuitry are two three-terminal regulator ICs type LM320 and LM340, from National Semiconductor. The LM340 is a positive voltage regulator and the LM320 is a negative regulator, though in all other respects they are similar. Their features include excellent regulation, current limiting and thermal overload protection.

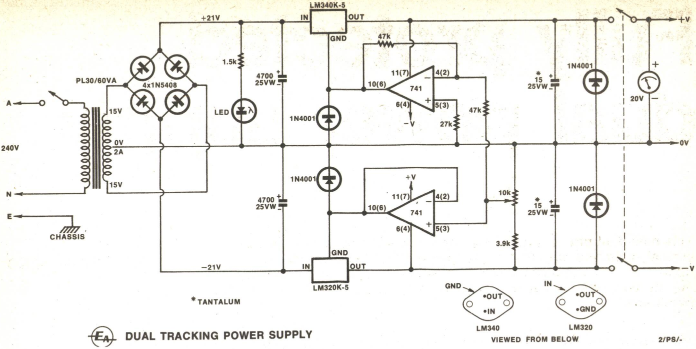
The LM320 is arranged in a negative supply circuit which provides a variable output voltage, while the LM340 is arranged in a positive supply whose output voltage is designed to track the output voltage of the negative supply. Hence the name dual tracking power supply.

Normally a three terminal regulator supplies a fixed output voltage with respect to its ground terminal. To change this situation and so achieve a variable output voltage, it is necessary to change the voltage at the ground terminal of the regulator. This is not difficult to do because even while the regulator is supplying large currents to the load, the current through its ground terminal is only of the order of a few milliamps.

Examining the negative supply first, it can be seen that the ground terminal of the LM320 regulator is connected to an LM741 op-amp arranged as a voltage



*A standard metal case was used to house the prototype. It can supply matched output voltages from ±5V to ±15V and has both power and load switching.*



**DUAL TRACKING POWER SUPPLY**

follower. The input of the voltage follower is obtained from a 3.9k resistor and 10k potentiometer which form a voltage divider at the output of the regulator. This has the effect of feeding an adjustable fraction of the output of the regulator back to its ground terminal.

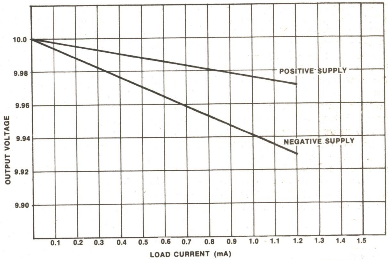
Referring to Fig 1, the fraction of the output voltage obtained from the voltage divider is $Rb/(Ra+Rb)$. Since the regulator is a 5V type its output voltage will equal this feedback voltage plus 5V. Expressing this as an equation relating output voltage to voltage divider resistance we have $Vo.Rb/(Ra + Rb) = Vo-5$. Rearranging these terms slightly the output voltage is more explicitly given by:

$Vo = 5(Ra + Rb)/Ra$.

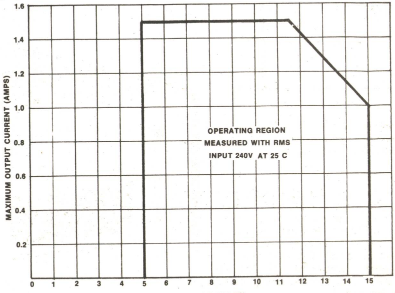
Hence by varying the voltage divider ratio we can change the output voltage of the supply. When for example the wiper of the potentiometer is set to ground, zero volts will be fed back to the ground terminal of the negative regulator and so the output voltage will be -5V. If the potentiometer is set to maximum, the output voltage will be -15V by virtue of the 3.9k resistor between the potentiometer and the output line.

It might be noted that this value of resistance is less than would be calculated by using the equation just discussed. The reason for this is that input resistance of the second LM741 op-amp stage has a loading effect on the voltage divider, since it is connected across the potentiometer. Its input resistance is of course 47k, due to the virtual earth at the inverting input.

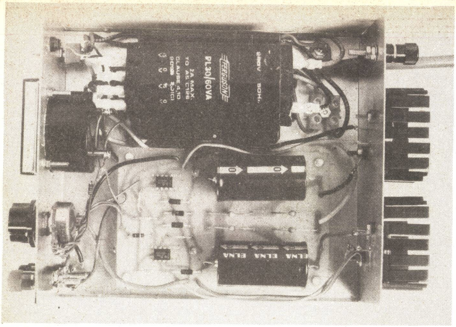
The purpose of the second LM741 is to provide a suitable voltage to the positive regulator, such that the positive supply voltage will track the



*This graph shows the regulation characteristics of the prototype.*



*Graph showing maximum output current as a function of output voltage.*



*Inside the completed prototype. A single PC board accommodates most of the components and will accept both 8-pin and 14-pin 741 op amps.*

## PARTS LIST

*1 Power transformer, 30V CT at 2A; Ferguson PL30/60VA or similar*
*1 Metal case 184 x 70 x 160mm (D x H x W)*
*1 PC board, 80 x 120mm, coded 79PS6*
*1 Meter, 20V FSD type MRA45B*
*1 SPDT miniature toggle switch*
*1 DPDT miniature toggle switch*
*1 10k rotary linear potentiometer*
*3 Black 4mm banana socket binding posts*
*1 Red 4mm banana socket binding post*
*1 Black knob*
*1 Large red LED bezel*
*2 TO-3 powerfin heatsinks 50mm square by 25mm high*
*2 sets of TO-3 mounting hardware, ie insulating bushes, mica washer, nuts and bolts.*
*4 Richco plastic board supports*
*1 Mains cord and plug*
*Grommet, cable clamp, termination block, solder lugs, hookup wire.*

*SEMICONDUCTORS*
*1 LM340K-5 positive regulator*
*1 LM320K-5 negative regulator*
*2 LM741 op-amps*
*4 IN5408 diodes*
*4 IN4001 diodes*

*CAPACITORS*
*2 4700uF 25VW electrolytic, axial lead type*
*2 15uF 25VW tantalum*

*RESISTORS ½ watt: 2 x 47k, 1 x 27k, 1 x 3.9k*

*NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may be generally used provided they are physically compatible.*

negative supply. If this is to be so then the magnitude of the voltage applied to the ground terminals of the two regulators must be the same but of opposite effective polarity. This is achieved since the LM741 is arranged as a unity gain inverter.

The unity gain of the inverter and therefore its tracking accuracy is conditional upon the matching of the two 47k resistors in its circuit. Tracking accuracy of the positive supply would thus be improved by the use of close tolerance resistors, so while 5% tolerance has been specified 1% resistors should be used if they are available.

The purpose of the 27k resistor in the non-inverting input of the op-amp is to reduce voltage drift as a result of any temperature changes. The value of resistance is chosen to be approximately equal to the effective DC resistance at the inverting input so that any increase in input bias current due to temperature contributes an equal change in input voltage at both inputs.

Having discussed the regulation circuit the rectifier and filter sections bear mentioning. The rectifier is a standard centre-tapped bridge rectifier employing 3-amp diodes and provides about ±12V. With the specified filter capacitors it is possible to maintain a reasonable ripple factor in the filter section, and hence extend the maximum current at high output voltages, without exceeding the VA rating of the transformer or the peak current rating of the diodes.

The remaining components do not directly affect the normal operation of the circuit. The diodes at the outputs of the op-amps are normally reverse biased, hence they do not interfere with normal operation. However when the supply is initially turned on they ensure that the ground terminal of either regulator is not dragged down to the opposite supply rail. This is important because the combined output voltage of the rectifier exceeds the maximum input voltage of the regulators.

We estimate that the current cost of parts for this project is approximately

**$45.00**

This includes sales tax.

Additional diodes have also been included at the outputs of the regulators. These are to prevent the outputs from being drawn below the zero voltage rail due to high common-mode loads, such as might occur with large bypass capacitors connected between the two output rails.

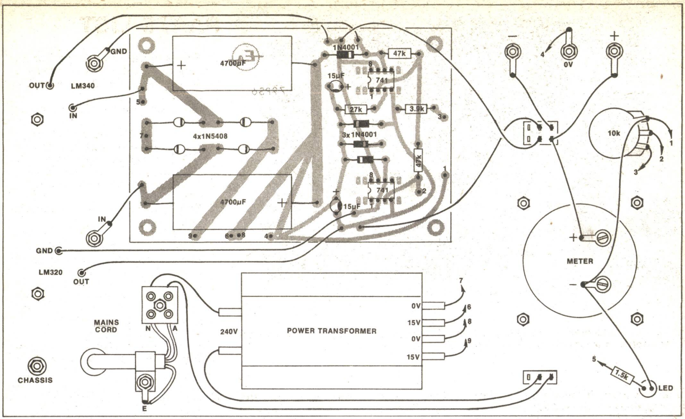
The 15uF capacitors at the outputs of the supply provide a better transient response for the output voltage. More importantly they also avoid instability by decoupling the supply lines. This is necessary because of the closed loop formed by the negative regulator, voltage divider and voltage follower, and also because of the additional feedback path via the op-amp supply lines.

Perhaps at this stage it would be worth mentioning why the op-amp supplies are actually obtained from the output of the regulators rather than directly at the output of the rectifier. This is not because of the reduced ripple content of the regulated supply, although this is an additional benefit. Rather it is because the output voltage of the rectifier, ±21V, exceeds the maximum supply voltage rating of the op-amps — which is ±18V.

An added bonus of this arrangement is that the op-amps also provide a load to the regulators in standby mode. This obviates the need for including hold-down resistors at the outputs of the supply.

Since the output voltage of the supply cannot be reduced to zero, a load switch has also been included. This switch is a double pole type and has the effect of disconnecting both the positive and negative supplies.

The power supply outputs are fully floating with respect to the case and to mains earth, so an additional terminal



*Use this diagram, together with the circuit diagram, to guide your construction of the power supply.*

connected to the rear of the case has been included. This may be connected to any of the supply outputs, to establish reference levels. Alternatively it can be connected to any associated equipment, to alleviate any hum or interference problems.

In our prototype the meter was wired after the load switch so that it would be immediately obvious when the supply was switched on. Alternatively the meter could be connected before the load switch if you desire. This would permit one to set the output voltage before connecting the supply to the load.

As a final note about the circuitry, it can be seen that the output voltage meter has only been connected to the positive supply without provision for monitoring the negative supply. This is not unreasonable as a compromise, as the positive supply tracks the negative supply. Hence if anything were to change the negative supply voltage, such as a short, it would still be reflected on the output meter.

Looking now to the maximum current characteristic of the supply in the adjacent diagram, there are two major factors which impose a limit on the maximum current available.

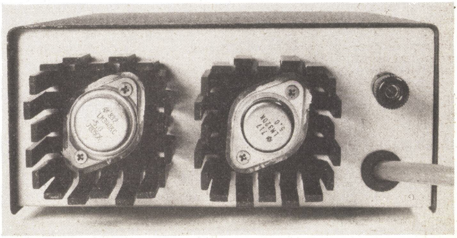
At low voltages the current is limited to 1.5A because of the internal current limiting of the three-terminal regulators themselves. At higher ambient temperatures or if smaller heatsinks are used the power dissipation may reduce this limit even further and the lower end of the curve will appear as a hyperbola.

Toward the end of the current limit diagram, at high output voltages, current is limited because of the increased ripple and reduced DC voltage available from the rectifier and filter.

The regulators require a minimum voltage between their input and output terminals to still maintain regulation. This is referred to as the "drop out" voltage and when the voltage across the regulators is reduced to this value due to large load currents and high output voltages, ripple will break through into the output. This leads to the straight line cutoff seen in the diagram.

To make assembly of the supply easier, I have designed a small printed circuit board (PCB) which supports most of the smaller components. The PCB measures 120 x 80mm, and is coded 79PS6. The pattern for the board is reproduced here actual size, for those who may wish to trace it or photographically copy it to make their own PCB, although boards will no doubt be available from the usual suppliers shortly.

Wiring of the PCB should be fairly



*Mica washers are used to insulate the voltage regulators from their respective heatsinks. Note the earth terminal at upper right.*

straightforward from the overlay diagram and photograph. Note that the PCB provides for both the 14-pin and 8-pin versions of the 741 devices, so that you can use whichever is available.

The PC board in our prototype was mounted in an inexpensive metal case with plastic board supports. The case and heatsinks were kindly supplied by Dick Smith Electronics whose catalog numbers for these items is H-2744 and H-3400. If you're using the suggested case, the wiring layout diagram and panel layout provided could be useful.

Mount the regulators and power transformer before mounting the PCB in the case. When mounting the regulators, drill the holes sufficiently large so that they do not interfere with the regulator terminals and sleeve the terminals with plastic "spaghetti" tubing. To improve thermal conductivity between the regulators and the heatsinks, silicon grease or other thermal conducting compound should be used.

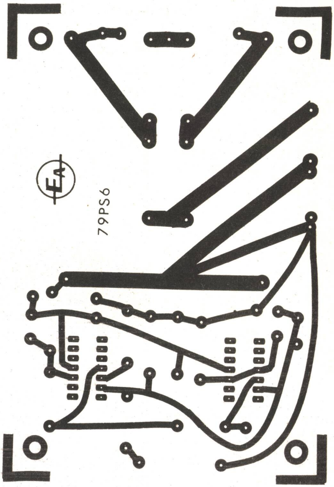
Before wiring them into circuit, check carefully that the regulators are actually insulated from the chassis with a multimeter or other continuity checker. This gives you the opportunity to take appropriate action if they are not.

The mains cord should enter the case via a grommeted hole and be clamped securely. The active and neutral wires should be terminated in an insulated terminal block and the earth lead soldered directly to a lug bolted to the chassis. Note that when mounting the transformer the primary leads should exit from the transformer on the side away from the PC board, to reduce the likelihood of shock.

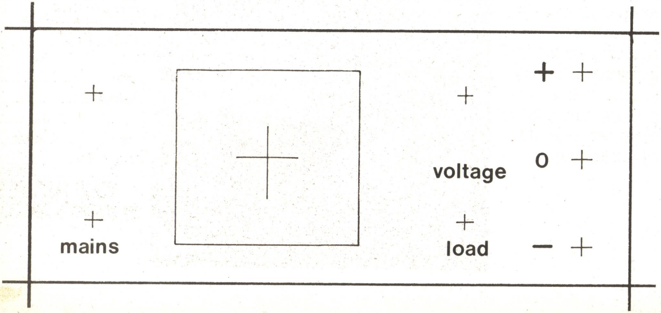
When wiring up the LED indicator note that the 1.5k resistor in series with the LED is not included on the PC board, so solder this resistor directly to one of the LED leads and insulate it with some plastic tubing.

After carefully checking the wiring of your supply, particularly the polarity of the electrolytics and diodes, switch on the mains and observe the output voltage meter reading. If anything is amiss, disconnect and recheck the circuit. Possible faults include incorrect wiring of the regulators, or the 741 ICs may not be orientated properly.

If all is well you should find the supply a very useful addition to your workbench, especially when working on op-amp circuits. Of course it can also be used for jobs which require a single supply, by using either one of the two outputs — or both in series if you need higher voltage.



*ABOVE: Here is an actual size reproduction of the PC pattern. BELOW: this full-size replica of the front panel can be used direct, or it may be copied.*



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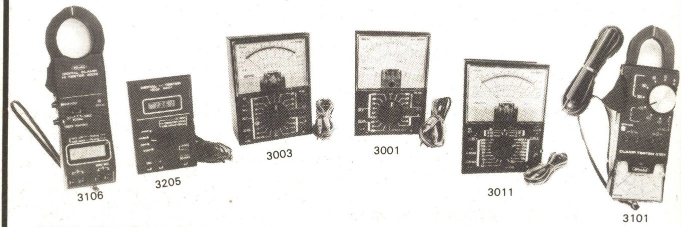

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10/50/250/1000V AC 2k Ω/V ±3%
3k/30k/300k ±3%F.S. R.C. 26Ω

**3002** PRACTICAL COMPACT TESTER
0.5/2.5/10/50/250/1000V DC 20k Ω/V ±3%
50 A/25/250mA ±3%
10/50/250/500/1000V AC 9k Ω/V ±3%
10k/100k/1M ±3%F.S. R.C.100Ω
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**3003** PRACTICAL MEDIUM CLASS TESTER
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50µ A/2.5/25/250mA/10A DC ±3%
10/50/250/1000V AC 13.5k Ω/V ±3%
10A AC ±4%
5k/50k/500k/5M ±3%F.S. R.C.50Ω
L.F. Output —20 to +36dB ±4%

**3005** HIGH CLASS TESTER WITH RELAY PROTECTION
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50uA/2.5/5/50/500mA/10A DC ±3%
10/50/250/1000V AC 10k Ω/V ±3%
10A AC ±4%
2k/20k/200k/2M ±3%F.S. R.C.20Ω
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10A AC ±4%
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25µ /50µ /100µ /250/2.5m/25m/250m/2.5A/10A DC ±2%
2.5/5/10/25/50/100/250/500/1000V AC 10k Ω/V ±3%
25µ /50µ /100µ /250µ /2.5m/25m/250mA/2.5A/10A AC ±3%
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# Antenna tuning unit covers all HF bands

To the mobile amateur HF operation has always presented a serious challenge and, while modern equipment is much more compact and reliable than that of a few years ago, there remains the major problem of providing an efficient aerial. Here is a simple aerial tuning unit having a wide range of adjustment.

by **G.D. FORREST B.Sc VK3AGF**

Just about any mobile antenna which may be required to operate on more than one frequency becomes a compromise in terms of best performance and acceptable standing wave ratio. In mobile activities, where every watt of power counts in a naturally adverse situation, experienced mobile operators have found that the performance of even "top-of-the-line" commercial mobile antennas can be noticeably improved by the use of an antenna tuning unit (ATU) between the transceiver and the antenna. Furthermore, the unit acts as a filter to reduce the possibility of interference to television sets. In addition, all amateur HF bands can be tuned with one whip, thus saving the cost of a series of whips.

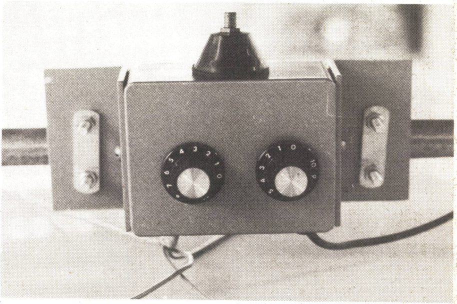
One approach is to put the ATU between the output of the transceiver and the coaxial cable to the antenna. Although this technique provides a distinct improvement in both radiated power and received signal strength it has the disadvantage that standing waves can still exist on the coaxial cable with an associated loss of performance.

Given then that the use of an ATU can provide the advantages outlined above, it follows that it should logically be inserted right at the base of the radiating element itself. As there are, to date, no commercially available units with this feature the author looked into the possibility of making his own and found it to be well within the abilities of any home constructor.

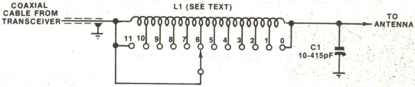
The unit to be described is designed to mount on a ski bar, but this is a mechanical option which could readily be adapted to other forms of mounting to suit the needs of the user, such as bumper, gutter or trunk lid mount. One advantage of some form of roof mounted antenna is that the relatively flat vehicle acts as a ground plane with a corresponding improvement in antenna performance. In addition, the author used four radial wires across the roof as described below, but this is completely optional.

As implied earlier, mobile HF antennas, at least below the 28MHz band, are essentially compromise devices. It is just not practical to accommodate a resonant (quarter wavelength) aerial on a car, for amateur bands below 28MHz.

The shortened aerial no longer presents a purely resistive load to the transmitter; it now has capacitive reactance, looking like a resistor in series



*The aerial tuning unit mounted on a ski bar above the car. The left hand knob controls the variable capacitor and the right hand one selects the inductor taps. Note the four "radials" used to improve the ground plane.*



*The basic circuit as used for the unit in the photograph above, and which puts the variable capacitor at the antenna end of the inductor. Subsequently the author modified the circuit, as shown elsewhere, and improved its performance.*

---

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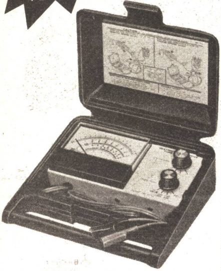

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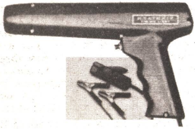

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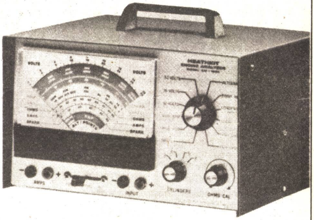

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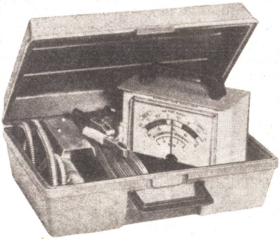

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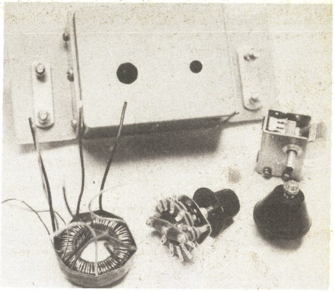
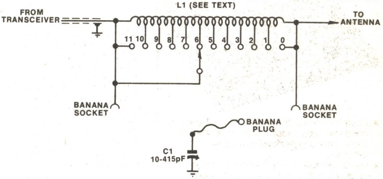


*The main components used in the tuning unit. The inductor, left, is wound on a toroid and details are given in the text. The box is supported on two aluminium brackets drilled to take "U" bolts, but conduit saddles can be used.*



*The author's modified circuit allows the variable capacitor to be connected to either end of the inductor and makes possible a greater tuning range. A good quality switch could be used in place of the plug and sockets.*

with a capacitor. As the frequency is made progressively lower, relative to the natural resonant length, this capacitance increases and the resistance decreases.

Such a situation is undesirable for two reasons. Firstly, the aerial is not very efficient as a radiating device and, secondly, the load which it presents to the transmitter may be a long way from the value for which the transmitter is designed. This latter condition prevents the transmitter from generating its rated power.

It is not usually possible to do much about the radiating efficiency of a short aerial but, regardless of this, it is very important to make the aerial look like a correct load for the transmitter. This at least allows the transmitter to develop its rated power.

The capacitive reactance of the shortened aerial can be cancelled by adding an appropriate amount of inductive reactance (a coil) in series with it. This coil may be at the base of the aerial (bottom loading) or part way up the aerial (centre loading).

But such a coil will serve only one frequency. If a single loaded whip is to be used on all bands, it would be selected for the highest band, and additional inductance inserted for the lower frequencies.

In simple terms, this is the job performed by the aerial tuning unit. For practical reasons a tapped coil is used and the fine adjustment provided by the variable capacitor.

Another way of visualising the situation is that the addition of the inductance takes the whole aerial system resonant, as it would be naturally if it was of the correct length. This enables it to present a more reasonable value of load, and one which is essentially resistive to the transmitter.

The completed unit is shown in the photograph, mounted on the ski bar with the radials running away below. The darker wire is, of course, the coaxial cable.

The left hand knob is for tuning the variable capacitor and the right hand knob for selecting the appropriate tap on the inductor, both shown on the schematic diagram.

As detailed below the inductor switch is wired to give no series inductance at position "0", to a maximum series inductance at position "11".

The coil consists of as many turns of 18SWG enamelled copper wire as can be conveniently wound on a two inch toroidal former. The toroidal former is an Amidon T200-2 which is available as part of a "balun kit" from Dick Smith stores. They are also advertised occasionally in "Amateur Radio." The coil depicted has about 65 turns. If a 12 position rotary switch is used, 10 taps are required. These were atached simply by baring the wire on the outside face of the toroid with fine emery paper at the required positions and then soldering on flexible leads about four inches long. The taps can be connected to every sixth turn, but it is probably better to make the first three taps at, say, 1,3 and 5 turns to allow a finer adjustment at the minimum inductance end. Finally, the coil was wrapped with plastic insulation tape.

The tuning capacitor is a standard 10-415pF single gang receiving type which is quite OK at powers up to about 200 watts. When mounting the capacitor make sure that sufficient of the shaft protrudes through the panel to enable the knob to clear the front surface. The larger hole in the panel is used for the tuning capacitor. A suitable rubber grommet in the hole both restricts the entry of water and acts as a friction brake to prevent rotation of the shaft due to road vibration.

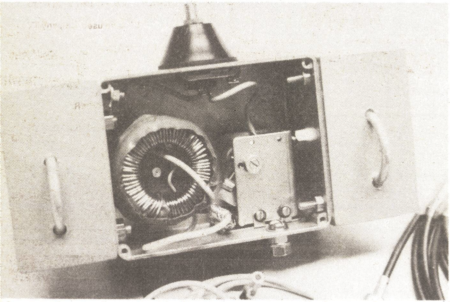
The interior photograph shows the general assembly of the unit. The coaxial feeder enters through a grommet in the base of the box left, under the coil

## PARTS LIST

*1 Toroid, 2 inch AMIDON T200-2*
*1 Eddystone box, or similar, 120 x 85 x 52mm*
*1 Roblan single gang variable capacitor, 10-415uF*
*1 1 x 12 rotary switch, Oak, Paton or similar*
*2 Knobs*
*20 feet 18SWG enamelled copper wire*
*1 Antenna mounting base, single hole roof mount*
*2 pieces aluminium angle 50 x 50 x 30, each 90mm long.*
*2 U-bolts 6mm (¼in) x 35mm centres*
*7 metal thread screw ¼in whitworth x ½in round head with nuts and washers*
*25 feet PVC insulated hookup wire 23/.0076*
*9 feet RG58U or RG59U coaxial cable*
*1 PL259 plug*
*Grommets, plastic self adhesive insulating tape, solder lugs.*

while the four earth radials are attached to the terminal shown just behind the tuning capacitor. This terminal is made from a ¼" whitworth screw and nuts. Wiring inside the box is heavy duty hookup wire, such as 23/.0076. There can be quite large circulating currents inside the ATU.

The radials, which are designed to improve the earth coupling of the unit into the car body are simply four lengths of hookup wire with alligator clips on the end to clip to the guttering at the four corners of the roof. These radials could be omitted, but in view of the relative inefficiency of mobile HF antennas any move such as this to improve the general efficiency should be adopted. The antenna base is any suitable type. Several are readily available through the trade.



*The complete tuning unit with the rear cover removed, showing the toroid and tuning capacitor. Note the large bolt behind the tuning capacitor which is used to terminate the "radials" which clip to the car guttering.*

The mounting brackets in this version are scrap pieces of aluminium angle which are screwed to the ends of the box and attached to the ski bar by U-bolts. As mentioned previously, any suitable type of mounting can be used. In a second and later version of this ATU the box was attached to the ski bar by a plastic conduit saddle which cost 5 cents. The box was spray painted before assembly, but after drilling, with the aid of a can of bronze hammertone spray.

In operation, with the antenna mounted on the base, the tuning capacitor is set to its approximate midpoint with a suitable monitoring device such as a field strength detector, SWR meter or, in the case of a solid state transceiver, the final collector current meter, the 12 position switch is rotated until maximum power output or minimum SWR is indicated. Then the tuning capacitor is varied slowly as a fine adjustment.

The unit will need to be retuned for each amateur band but, in most cases, it should be possible to find a compromise setting for any one band which will remain effective across that band or the portion of interest.

Since I submitted my original design I have found that the simple modification of arranging for the tuning capacitor to be connected either on the antenna OR the transmitter side of the inductor greatly extends the range of antenna impedances which can be matched to the transmitter. I did this simply by incorportating two banana sockets on the front panel towards top centre and connecting these inside the box to the transmitter and antenna ends of the coil. The non-earthed side of the capacitor was lifted off the antenna side of the coil and brought out by hook-up wire through a grommet to a banana plug.

The much greater range of impedance match available allows me to use the coupling unit with shorter whips, if desired, and also to use the equipment in the "stationary mobile" mode when I connect a wire antenna from a tree or similar support to the antenna base in place of the whip.

The all-up cost, depending upon how much the junk box yields, should not exceed about thirty dollars. The writer ventures to suggest that this unit will give a greater benefit per dollar in terms of station performance that any other accessory. Since the prototype was put into service the author has logged amateur HF contacts with several United States stations, one each in Germany and Denmark, plus many Australian and New Zealand stations.

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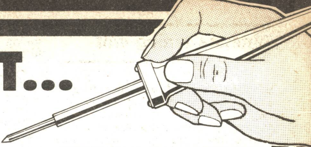

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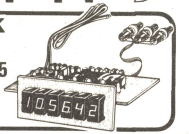

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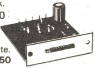

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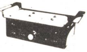

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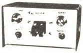

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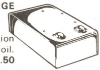

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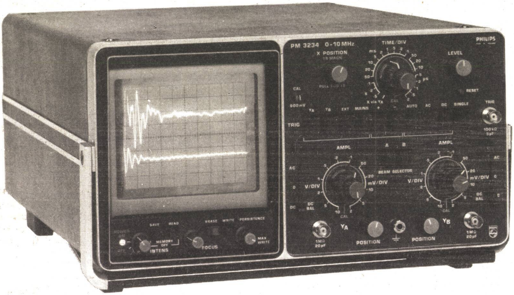
# DICK SMITH ELECTRONICS

# A true dual beam oscilloscope

## 10 MHz continuous displays for real time and storage



True dual beam operation in Philips. PM3234 10 MHz: 2 mV oscilloscope gives bright, continuous displays and thereby eliminates the phase error problems of time-shared instruments.

- ☐ Variable persistence means flicker free display.
- ☐ Comprehensive triggering facilities
- ☐ Line or 24 Volt D.C. operation
- ☐ Easy operation — logical front panel layout.

**What is true dual beam operation?**

It is an improved display technique in which two beams are generated in one gun. The X-plates are shared but the Y-plates are entirely separate and driven independently, thereby removing the need for chopped or alternate modes.

The resulting continuous display eliminates ambiguity in the triggering conditions.

As well as this important benefit, the technique also allows twice the normal light levels to be employed.

**New storage possibilities**

The combination of true dual beam operation and "half tone" storage is absolutely ideal for single shot and random signals. These phenomena are exactly the kind that can and do get lost in a time-shared instrument.

The PM3234 ensures that the whole signal is seen and captured for up to 15 minutes at minimum brightness.

Variable persistence is adjustable from 0.3 seconds to 1.5 minutes for clear display of those difficult-to-see signals. The PM3234 is one of the most versatile and easy-to-operate storage instruments on the market.

For a demonstration contact:

**Philips Electronic Systems — Scientific & Industrial Equipment**
P.O. Box 119, North Ryde, N.S.W. 2113.
Phone: Sydney 888 8222;
Melbourne 699 0300; Adelaide 223 4022;
Perth 277 4199; Brisbane 264 1946.

PHILIPS

**Test & Measuring Instruments**

**PHILIPS**

HRME 132.0033

### Fitting a crystal oscillator to the

# New video ball game

The New Video Ball Game was first described in the July 1978 issue (File No. 3/EG/10) and has proved extremely popular, large numbers of kits having been sold. Unfortunately, some constructors have struck trouble, almost invariably involving the clock oscillator feeding pin 9 or the AY-3-8600 chip. This was a simple self-excited oscillator circuit, using a 100uH coil and a BC548 transistor. It has sometimes failed to oscillate at all, or has oscillated on the wrong frequency.

This appears to have been due almost entirely to variations in the 100uH coil characteristics and, with the benefit of hindsight, it would seem that the suggestion that this could be scramble wound may have been optimistic. While we have not had a chance to try it ourselves, some readers have reported that failure to oscillate has been cured by layer winding the coil.

A more positive cure is to change the oscillator to a crystal controlled type, using a relatively inexpensive NTSC colour TV crystal on 3.57954MHz. This not only ensures reliable oscillation, but also the correct frequency.

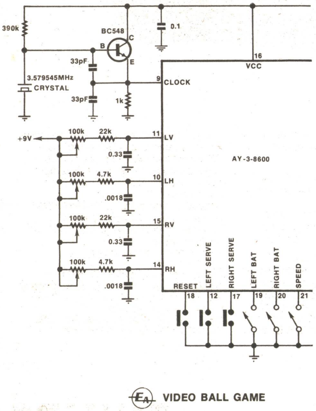
One of our advertisers (Dick Smith Electronics) has already marketed a kit using a crystal, with a modified printed board. This firm can also supply the crystal for those who would like to modify their existing units.

The modification involved is quite simple, and a new board is not really necessary. All that is needed is to drill one extra hole in the existing board. This is to accommodate one of the crystal pins, and it is located in the earthy copper pattern over which the coil was originally mounted. The exact position depends on the spacing between the crystal pins, which is 10mm for the crystal we used.

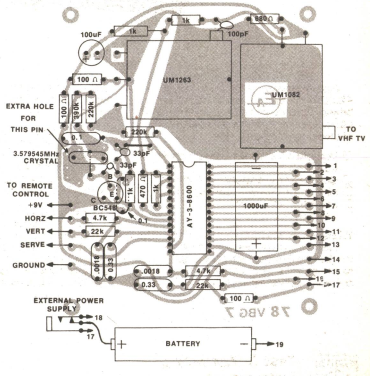
Other changes involve adding a link between the two holes which previously terminated the coil connections, shifting one of the 33pF capacitors, discarding the 56pF capacitor, and changing the 100k resistor to 390k. All this is shown on the accompanying modified overlay diagram and modified circuit. Note that some holes are no longer used after these changes.

The crystal is designed to be soldered directly to the board, and so the link mentioned above should be fitted first. It runs above the board, but beneath the crystal.

These changes should not take more than a few minutes to implement and when completed, should allow the unit to work immediately, as there is no adjustment required for this part of the circuit.



*The relevant portion of the Video Ball Game circuit, showing the crystal oscillator (top left) used in place of the original self-excited oscillator.*



*The modified overlay diagram showing location of the crystal and the other minor changes. Only one extra hole has to be drilled to accommodate the crystal.*

## Accurate frequencies from 4kHz to 2MHz!

# Quartz multiple frequency reference

This relatively simple unit will give any of a series of accurately controlled reference frequencies, derived from a 2MHz crystal via a switched binary divider arrangement. A large number of frequencies is possible, ranging from 2MHz to just under 4kHz.

### by IAN POGSON

It all started several weeks ago when two members of our staff were contemplating a new project. The need for an accurate frequency reference arose, in order to follow through with the particular project. The need was met in a satisfactory way at the time, but it pointed up the need for a simple but reliable frequency reference. And so the idea of our new Quartz Multiple Frequency Reference was born.

When the idea for a project arises, quite often it goes through many phases before the final design is arrived at. This one was no exception. The idea of starting off with a 10MHz crystal seemed to be a good one. For one thing, harmonics of 10MHz could be useful well into the VHF region and this seemed to be a good enough reason for adopting this approach. Indeed, a rough prototype was produced and made to work quite satisfactorily. However, there were problems.

Right from the start the aim was to keep the circuitry as simple as possible, so maintaining a useful device at a reasonable cost. While the first prototype was relatively simple, it was not possible to use low-power CMOS devices throughout as they would not be a reliable proposition at as high a frequency as 10MHz.

This meant that we had to use a 74LS90 low power Schottky device for division from 10MHz down to say 2MHz. At this stage, we were running the CMOS devices and the 74LS90, together with a 74LS04 hex inverter, from the 5V supply.

Unfortunately this arrangement turned out to be unsatisfactory due to lack of speed in the operation of the CMOS devices when operated at 5V. Increasing the supply voltage to 12V seemed the only solution and indeed, this proved to be the case. However, this introduced the real problem of having to operate the CMOS devices from 12V and the LS devices from 5V. Furthermore, this posed the necessity of interfacing between the two different types of devices.

It was difficult to solve these problems without sacrificing simplicity, so the whole project had to be given more thought. All of the problems could be solved by dropping the idea of using a 10MHz crystal and settling for one at 2MHz. All things considered, this seemed to be the best way out and this is the method which we have adopted. While it must be conceded that harmonics of 2MHz will normally not be usable up to as high frequencies as could be expected from a 10MHz source, this seemed to be a fair price to pay. A look at the circuit will show how it has worked out.

| Frequency | us | Switch |
|---|---|---|
| 1MHz | 1 | 1 |
| 500kHz | 2 | 2 |
| 250kHz | 4 | 4 |
| 200kHz | 5 | 1,4 |
| 125kHz | 8 | 8 |
| 100kHz | 10 | 2,8 |
| 62.5kHz | 16 | 16 |
| 50kHz | 20 | 4,16 |
| 40kHz | 25 | 1,8,16 |
| 31.25kHz | 32 | 32 |
| 20kHz | 50 | 2,16,32 |
| 10kHz | 100 | 4,32,64 |
| 8kHz | 125 | 1,4,8,16,32,64 |
| 5kHz | 200 | 8,64,128 |
| 4kHz | 250 | 2,8,16,32,64,128 |

*This table shows the switch combinations for various frequency outputs from the instrument. Note that the delay in microseconds (us) is equal to the sum of the switch settings.*

The crystal oscillator is just about as simple as it could be, consistent with meeting the demands of a stable performance. It uses a dual gate MOSFET in a modified Pierce oscillator. Some of the output from the drain is fed back to G1 via a 120pF capacitor, with a silicon diode connected between G1 and ground. This part of the circuit comprises an AGC system, thereby controlling the output level of the oscillator, a very desirable feature. Claims for this oscillator are that there is very little change in oscillator frequency due to supply voltage and temperature changes. This virtually leaves only frequency changes due to the crystal itself.

The output from the crystal oscillator is low in harmonic content and at a fairly low level, not suitable for driving the 4013 dual D flipflop. Accordingly an interface buffer stage using a 2N706 high speed switching transistor has been added. The output of this stage drives the clock input of one half of the 4013. In addition, the 2MHz output is also fed to one of the 4009 inverters, and finds its way to the output socket via the selector switch and output level control.

The first section of the 4013 is connected in front of a 4024 7-stage ripple-carry binary counter/divider (IC 2) to make an 8-stage system. The respective outputs are fed into a 4068 8-input NAND gate via a bank of 8 SPDT toggle switches. The output from pin 13 of the 4068 is split and one part goes via three sections of the 4009 inverters to reset the 4024 and the 4013. The other part is used to feed the second section of the 4013, which is used as a divide by 2 and squarer stage for the output from the divider system. This arrangement means that we can set the bank of switches in terms of microseconds corresponding to the period of the wanted output frequency.

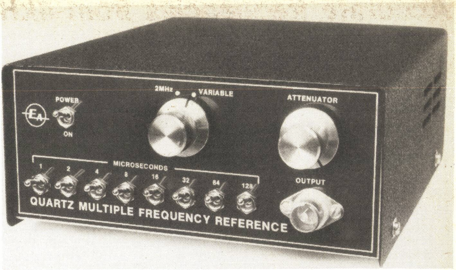
The selected frequency output from pin 13 of the 4013 is buffered like the 2MHz output by feeding it through another one of the 4009 inverters. The remaining sixth inverter is not used. Either output as selected by the two-way rotary switch is fed via a protective diode and limiting resistor to a 500 ohm level control prtentiometer. The output approximates a square wave, and is about 2V peak-to-peak.

Power is derived from a type PL15/5VA PCB-mounting transformer, feeding a full-wave bridge rectifier and filtered with a 2200uF capacitor. The resultant DC voltage is regulated with an LM340T-12 IC, giving a well regulated 12V DC supply.

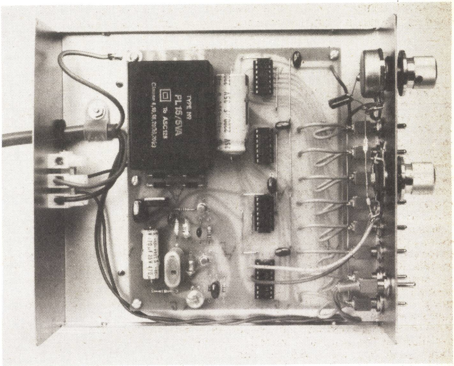
Components for the unit should be readily available, there being no special parts required, except possibly for the crystal. Undoubtedly, the crystal is a vital component and the overall performance of the instrument depends upon it. The crystal which we used is one which we happened to have on hand. It is a standard unit and the specifications are given in the parts list. The important question is where suitable supplies are available, and the delivery time which may be expected.

Crystals should normally be available from such people as Bright Star in Melbourne. Also, it is possible to send overseas to such suppliers as Texas Crystals, 1000 Crystal Drive, Fort Myers, Florida, USA and Interface Quartz Devices, 29 Market Street, Crewkerne, Somerset, TA18 7JU, in England. Also we understand that there is a local supplier with components off the shelf at the wanted frequency and at a reasonable price. Inquiries should be directed to D. Bowen, P.O. Box 123, Beecroft, NSW 2119.

As may be seen from the pictures, the instrument is housed in an attractive metal box. Most of the components are accommodated on a PC board, with switches, output socket and attenuator mounted on the front panel. The mains flex enters at the back and is terminated on a terminal block on the back panel. The PC board is fixed with five ½in long tapped spacers. The label on the front panel of the prototype was done with "Scotchcal".



*The prototype was built into a standard metal case. Eight toggle switches and one rotary switch give accurate square wave frequencies from 4kHz to 2MHz.*



*A single PC board accommodates most of the components.*

The printed board we have produced measures 113 x 138mm, and is coded 79fr6. It is made to take the PCB-mounting transformer made by Ferguson. This transformer is readily available and you should be able to get one through your local supplier.

General components, including transistors and ICs are standard items and are readily available at the time of writing. Details of the PCB are being made available to manufacturers as usual and supplies should be forthcoming by the time this appears in print. The box housing the unit is a popular line stocked by Dick Smith Electronics and should be available from any of their stores.

Construction of the instrument is best done by starting with the printed board assembly. The usual care should be taken. For soldering, a good hot iron is a must and all soldered joints should be done with care, making sure not to overheat any components. If you decide to use sockets for the ICs, then the only care required here is to make sure that no solder bridges are left across adjacent pin connections. On the other hand, if you wish to solder the ICs directly into the board, then the usual care should be taken when soldering CMOS devices. The barrel of the soldering iron should be connected to the earthy copper on the board via a length of flexible clip lead.

We suggest that you start off by fitting the ten tinned copper wire links.

# L. E. CHAPMAN

122 PITT RD, NTH CURL CURL
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## TRANSISTORS

| | |
|---|---|
| AD161-162 | $2.50 pair |
| OP9524 | ea. 50c |
| 2SC901A | ea $1.50 |
| BD139 | 50c |
| OC969 | 4 for $1 |
| OC967 | 4 for $1 |
| OC968 | 4 for $1 |
| OC9554 | 50c |
| DS113AE | 50c |
| 2N1110 | 4 for $1 |
| C1048c | 2 for $1 |
| OC955 | 50c |
| OC951 | 50c |
| 2SC154A | 50c |
| A209D | 4 for $1 |
| 2SB75 | 50c |
| 2SA15 | 50c |
| 2SB405 | 50c |
| 2SA351 | 50c |
| 2SA350 | 50c |
| BD238 | 50c |
| B1544 | 50c |
| D3300 | 50c |
| B514E | 50c |
| C1048D | 50c |
| BC548B | 10 for $1 |
| AT473 | 50c |
| B875F | 50c |
| 2SB303 | 50c |
| A437 | 50c |
| 0324 | 50c |
| A436 | 50c |
| 2SC179 | 50c |
| 2SB77 | 50c |
| C105H | 50c |
| AT323 | 4 for $1 |
| AT350A | 50c |

## DIODES

| | |
|---|---|
| OA636/1000 volt | 50c |
| OA662 | 4 for $1 |
| DELCO 2N174 | $2.50 |
| AD4002 | 4 for $1 |

## RESISTORS

150 ohm, 5W, 20c
10 ohm, 5W, 20c
47 ohm, 5W, 20c
12 ohm, 3W, 20c
2.5 ohm, 3W, 20c
33 ohm, 3W, 20c
8 ohm, 10W, 25c
4000 ohm, 10W, 25c
1000 ohm, 5W, 20c
330 ohm, 10W, 25c
220 ohm, 5W, 20c
5 ohm, 5W, 20c
220 ohm, 10W, 25c
950 ohm, 3W, 20c
115 ohm, 5W, 20c
10 ohm, 5W, 20c
1k ohm, 5W, 20c
5000 ohm, 5W, 20c
6.8k ohm, 3W, 20c
330 ohm, 10W, 25c
6800 ohm, 10W, 25c
1500 ohm DUAL, 21W, 50c
50 ohm, 5W, 20c
330 ohm, 5W, 20c
1k ohm, 5W, 20c
820 ohm, 5W, 20c
12 ohm, 10W, 25c
470 ohm, 7W, 20c
4700 ohm, 4.5W, 20c
5000 ohm, 10W, 25c

## ELECTROS

| | | |
|---|---|---|
| 470uF | 25V | 5 for $1 |
| 400uF | 10V | 5 for $1 |
| 47uF | 63V | 5 for $1 |
| 350uF | 16V | 2 for $1 |
| 27uF | 160V | 5 for $1 |
| 25uF | 63V | 10 for $1 |
| 22uF | 160V | 10 for $1 |
| 47uF | 16V | 5 for $1 |
| 47uF | 200V | 5 for $1 |
| 2200uF | 10V | 10 for $1 |
| 68uF | 16V | 10 for $1 |
| 1000uF | 25V | 5 for $1 |

## CAPACITORS

| | | |
|---|---|---|
| 0.011uF | 1500V | 30c ea |
| 0.0039uF | 1500V | 20c ea |
| 6N8 | 1500V | 20c ea |
| 0.0068uF | 1500V | 20c ea |
| 1200PF | 400V | 10 for $1 |
| 0.068uF | 400V | 5 for $1 |
| 2200PF | 630V | 10 for $1 |
| 0.47uF | 250V | 10 for $1 |
| 0.10uF | 400V | 5 for $1 |
| 0.082uF | 160V | 10 for $1 |
| 26k | 250V | 10 for $1 |
| 0.041uF | 400V | 10 for $1 |
| 0.033uF | 250V | 5 for $1 |
| 0.027uF | 100V | 20 for $1 |

## SPEAKERS

| | | |
|---|---|---|
| MSP | 9 x 6 15 ohm | $6.00 |
| | 9 x 6 8 ohm | 6.00 |
| 12 watt | 8 inch dual cone 8 ohm | 9.00 |
| | 7 x 5, 15 ohm | 5.50 |
| | 7 x 5, 8 ohm | 5.50 |
| | 6inch dual cone, 8 ohm | 5.00 |
| | 6 inch single cone, 15 ohm | 5.00 |
| | 6 inch dual cone, 27 ohm | 8.50 |
| | 5 inch dual cone, 27 ohm | 5.00 |
| | 5 inch single cone, 3.5 ohm | 3.50 |
| | 5 inch single cone, 8 ohm | 3.50 |
| | 5 inch single cone, 15 ohm | 3.50 |
| | 4 inch dual cone, 4 ohm | 6.00 |
| | 6 inch dual cone, 3.5 ohm | 6.00 |
| | 4 inch single cone, 15 ohm | 3.00 |
| | 4 inch single cone, 27 ohm | 4.50 |
| | 5 x 3, 27 ohm | 3.50 |
| | 5 x 3, 47 ohm | 3.50 |
| | 7 x 5, 3.5 ohm | 5.50 |
| 12 watt | 8 inch dual cone, 3.5 ohm | 8.50 |
| | 5 x 7 single cone, 27 ohm | 5.50 |
| | 3 inch, 8 ohm | 2.50 |
| | 6 x 4, 8 ohm | 2.50 |
| | 6 x 4, 15 ohm | 2.50 |
| | 6 x 9, 27 ohm | 6.50 |
| | 6 x 9, 47 ohm | 6.50 |

### SPECIAL

$1 pair 2¼ inch
5 x 3, 8 ohm
2 for $3

### SPECIAL

8 x 4, 15 ohm, $4
8 x 4, 8 ohm, $4
3¾ inch, 8 ohm, $1.50
6 x 9, 3.5 ohm, $6

6 inch dual
cone, 4 ohm, $5

### SPECIAL

100 mixed resistors, all useful, $2
100 Mixed capacitors, fresh stock, $2

### AUDIO LEADS

3.5m to 3.5m, 7ft, 75c
3.5m to 6.5m, 7ft, 75c
6.5m, 7ft, 50c

### MICRO SWITCH

5A, 250V AC, 75c each

### TUNING CAPS

2 and 3 gang, $1 each
min 2 gang, 50c

### FUSES

0.5A, 2A, 3.25, 10 for $1
In line fuse holders, 30c
RCA jack plugs and sockets, 40c pair

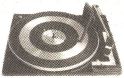
### PILOT LIGHTS

Screw in 6.3V, 10 for $10.50
12V, 10 for $1
24V, 10 for $1

100 Mixed Resistors, all useful.
**$2.00**

Special! 100 mixed capacitors — fresh stock, all useful.
**$2.00**

## SUPER SPECIAL



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15 watt RMS including 2 6in dual cone, each cabinet $16 each. P&P NSW $2.50; Interstate $3.50, WA $4.50.

**TRANSISTOR EAR PIECES PLUGS AND LEADS, 3 FOR $1**
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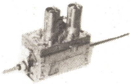
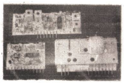


## TV TUNER VALVE TYPE

**$2.50**

Including valves
P&P $1.00
Interstate $2.50

## SUPER SPECIALS



### FM STEREO TUNER KITS

SETS OF 3 MODULES INCLUDE FM TUNER, DECODER & IF/DETECTOR. CIRCUIT DIAG. SUPPLIED; CAN BE USED WITH AMP MODULES.

**ONLY $18!**
PP $1

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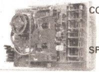

COMPLETE WITH HEADS & CIRCUIT FOR AMPLIFIERS FOR THE DECK.

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SPARE ERASE HEADS for above $2 ea

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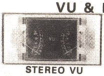
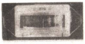
REVERSIBLE
**only $2 each**

## VU & BALANCE METERS



**STEREO VU**
**$3**



12 Kn 100uA
**$2**

PHILIPS
TV TUNER
Transistor
NT3030
NT3032
Colour—PP $1
**$10 ea**

## Frequency reference

This should be followed by such small components as resistors and diodes, followed by capacitors and leading up to the larger components, finishing up with the transformer.

During this process, it is very important to observe polarities with such components as electrolytic capacitors, transistors, diodes and ICs. The correct polarity is shown in each case on the circuit diagram.

Having fitted the components to the board, it is a good idea to carefully check the work thus far, making sure that all components are in the right place and the polarities are correct. A number of lengths of hookup wire also have to be soldered to appropriate points on the board; most of them will be terminated on the various switches. Leads are also required to run from the 240V transfromer terminals to the mains switch and terminal block.

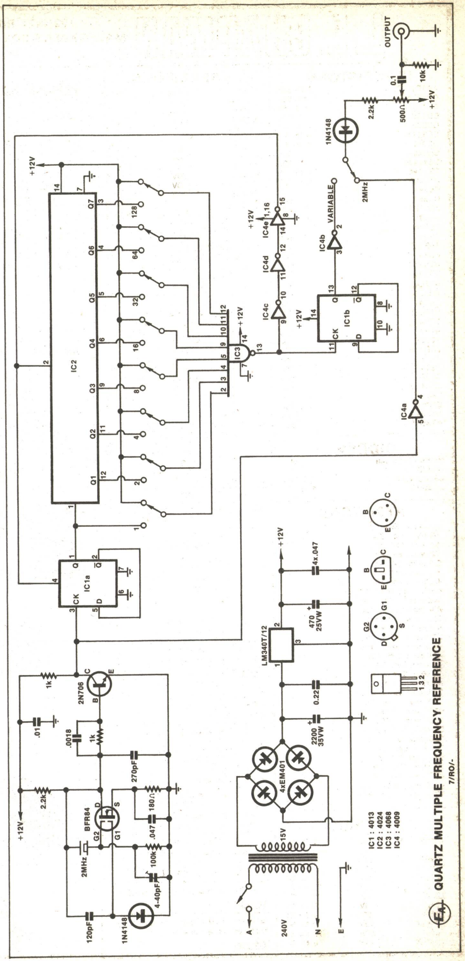
With the board assembled, it may be put aside for the time being and the various components fitted to the front and back panels. The eight toggle switches should be mounted, making sure that they are all parallel with each other. At this stage, a length of tinned copper wire is soldered along and connecting all the bottom lugs of the switches together. These will be connected to the +12V line later on.

The rest of the items may now be fixed to the front panel. A solder lug is needed under one of the fixing nuts for the coax socket, with a 0.1uF capacitor from the same point to the centre lug of the attenuator. A 2.2k resistor and a 1N4148 diode are connected in series and run between the attenuator and the common point on the "2MHz — Variable" selector switch. The junction of the resistor and the diode are soldered together, forming one continuous lead.

Using the five spacers, the printed board assembly may now be fixed in position. It should be so arranged that there is a space of about 2-3mm between the front edge of the board and the lugs on the row of eight toggle switches. With the board in place, the +12V lead should be terminated onto the common line of the switches. Following this, the leads nearest the edge of the board are terminated to the middle lug of each respective switch. The next row of leads are connected to the top lug of each switch. Just sufficient lead length should be left so as to make a neat gooseneck of each lead.

The two leads emerging from the board adjacent to the 4009 IC are terminated on the respective lugs of the rotary selector switch.

On the back panel, a rubber grommet should be provided for the mains lead and a three-terminal block



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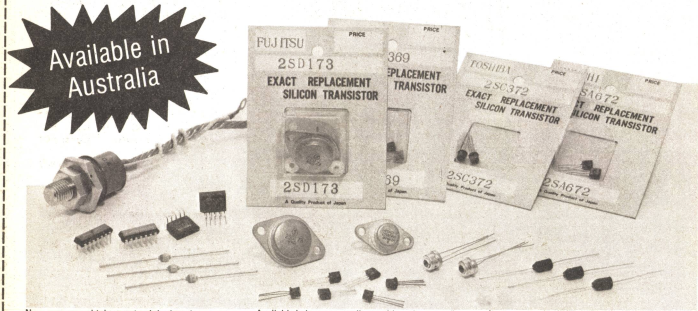

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| AN7150 | 4.26 |
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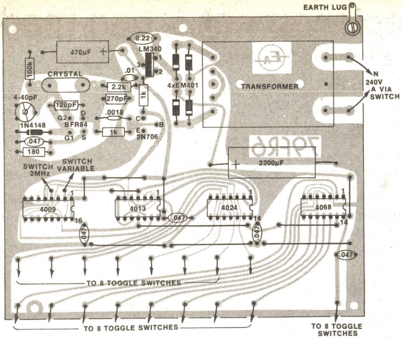

*This component overlay diagram shows the PC board as viewed from the component side of the board. Take particular care when inserting polarised components.*

for its termination. Only two of the block positions are used, the earth lead being brought directly to a lug under the screw head on the board in the corner next to the transformer. The mains lead should also be clamped just inside and near to the rubber grommet. During the wiring of the mains cord leads to the terminal block, the appropriate leads are also run to the transformer terminations on the board and to the mains switch on the front panel.

At this stage, construction is virtually complete and a careful check should be made to ensure that all is well before switching on. To make some checks on the instrument, a receiver and/or a CRO can be put to good use. Satisfied that there are no errors, power may be applied. A check on the supply voltage should verify that it is very close to 12V.

If you have a CRO, then the output of the Frequency Reference may be fed into it. Set the attenuator for full output and the selector switch to 2MHz. You should have a square wave at 2MHz on the screen. Set all the eight "microsecond" switches to the up or off position and reset the selector switch to "variable". There should be no signal on the screen. Operate the 1 microsecond switch and you should then have a 1MHz square wave on the screen. Similarly, as you operate the microsecond switches, you should get the appropriate frequency square wave displayed on the screen. It may be just as well to check that the attenuator control is working normally.

If you have a receiver capable of covering a wide range of frequencies, then this may be used to check for proper functioning of the Frequency Reference. It is a good idea to check the 2MHz output first, by setting the output to this frequency as before and by tuning the receiver to 2MHz or a harmonic thereof. Rather than connecting the output of the reference directly into the aerial terminal of the receiver, it should only be necessary to bring a lead from the output socket close to the aerial lead on the receiver.

We estimate that the current cost of parts for this project is approximately

**$55**

This includes sales tax.

You may then proceed to set up other frequencies and to tune in either to the fundamental or a harmonic. During this process you may take the opportunity to calibrate the crystal frequency against a standard, such as VNG, on 7.5MHz or 12MHz during daylight hours, or 7.5MHz or 4.5MHz during the hours of darkness. Other frequency standard transmissions such as WWV may also be used if convenient.

To do the calibration, first select the transmission which you intend to use. Then you must select a subharmonic from the Frequency Reference to suit. If you use VNG on 12MHz, or WWV on 10MHz, then the 2MHz output may be used. On the other hand, if you choose VNG on 7.5MHz (which is more than likely) then you will need to select say the 500kHz output from the Frequency Reference.

## PARTS LIST

*1 Metal box 184mm x 70mm x 160mm*
*9 SPDT miniature toggle switches*
*1 Rotary switch SPDT*
*1 Belling Lee coax socket*
*1 500 ohm linear potentiometer*
*2 Knobs to suit*
*1 Printed board 137mm x 114mm, code 79FR6*
*5 Brass spacers ½in long tapped ⅛in Whitworth*
*1 Transformer, Ferguson PL15/5VA*
*1 Crystal, 2000kHz, 20 to 30pF, ambient temperature, HC6/U or HC33/U holder*
*1 Socket to suit crystal (if required)*
*1 Transistor BFR84*
*1 Transistor 2N706*
*2 Diodes 1N4148*
*4 Diodes EM401 or similar*
*1 IC, LM340T-12*
*1 IC, 4009*
*1 IC, 4013*
*1 IC, 4024*
*1 IC, 4068*
*1 IC socket 16-pin DIL*
*3 IC sockets 14-pin DIL*

*RESISTORS (½W)*
*1 x 180 ohms, 2 x 1k, 2 x 2.2k, 1 x 10k, 1 x 100k.*

*CAPACITORS*
*1 4-40pF Philips trimmer*
*1 120pF polystyrene*
*1 270pF polystyrene*
*1 .0018uF greencap*
*1 .01uF greencap*
*5 .047uF greencap*
*1 0.1uF greencap*
*1 0.22uF greencap*
*1 470uF 25VW electrolytic*
*1 2200uF 35VW electrolytic*

*MISCELLANEOUS*
*Hookup wire, 20G TC wire, solder, solder lug, screws, rubber grommet, 3-core flex, 3-pin plug, cable clamp, cable terminal strip.*

*NOTE: Resistor wattage ratings and capacitor voltage ratings are those used on the prototype. Components with higher ratings may generally be used providing they are physically compatible. Components with lower ratings may also be used in some cases, provided the ratings are not exceeded.*

Having made the above choices, then the amount of signal fed into the receiver must balance the received signal so that a beat note can be readily discerned. Too strong a signal from the Frequency Reference will blanket the received frequency standard signal making the beat note hard to detect.

Assuming that all this has been done and a beat note established, then the 4-40pF trimmer of the oscillator should

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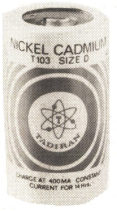
# NI-CAD AND LITHIUM CELLS



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The cells are cylindrical, physically interchangeable with conventional dry cells and they range from 0.45 Ah to 6.6 Ah in capacity. The sintered-plate construction of the cells results in low internal resistance and permits high-rate discharge. The cells are ruggedly constructed in nickel-plated steel cans with spot-welded internal electrical connections.

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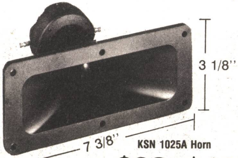

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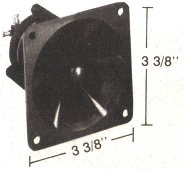

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be very carefully adjusted for a zero beat condition. This is not easy to do particularly if some accuracy is sought. The beat note will fall below audibility from the speaker (or headphones) and by careful adjustment, the S meter on the receiver may be used to get very close to zero beat.

With the tests and calibration completed, the instrument is ready for whatever use you may have for it. These uses may be all the way from calibrating receivers in the RF regions, down to references for audio use.

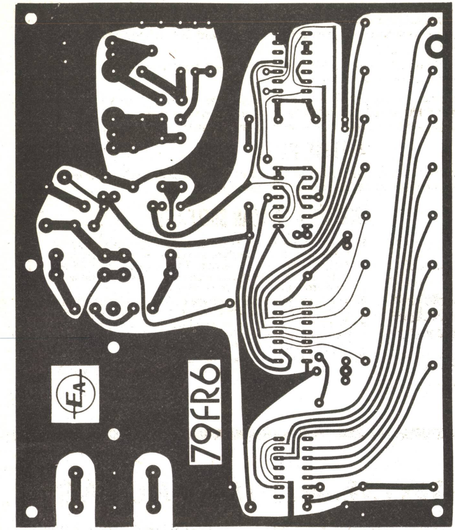
To facilitate its use, we have provided a table giving some of the more commonly used frequencies, showing how that frequency may be set up on the instrument. By way of a couple of examples, suppose that you need 200kHz. Then the selector switch will be set to "variable" and the "microseconds" switches will be set to 5, or 1 and 4. If you want 10kHz, then you will set the switches to 100, or 4, 32 and 64. And so on.

It will be readily understood that this unit will only give those frequencies which can be set up on the switches. But this is a limitation which should not cause too much inconvenience. When it is considered what the instrument will do for the amount of complexity and cost involved, it seems acceptable.

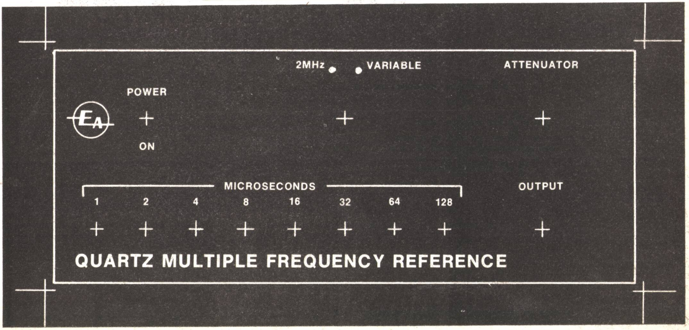
There may be times when an approximate frequency will serve the purpose quite well. If, for instance, you need about 9kHz, then this may be approximated by dividing by 111. This gives 9.009009kHz, which may be near enough for the particular purpose.

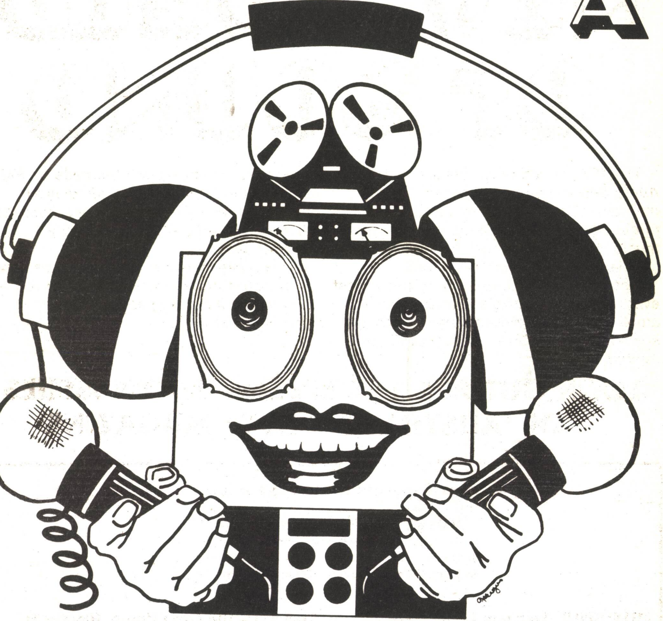
Finally, we were interested to check

(Continued on p125)



*Actual size reproductions of the PC board (left) and the front panel artwork (below). The front panel may be cut out and used directly, if required.*





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# Protecting solid state power supplies

It is becoming increasingly important for solid state power supplies to be protected against overload and short circuits. Not just for the protection of the power supply itself, but also — and often more importantly — to prevent damage to the equipment or circuits it powers. This article reviews many of the protection methods which are available.

**by VIJAY PRADHAN**

Tata Hydro-Electric Power Supply Co Ltd, Bombay, India

The power supply is an important part of any system. It should not only be reliable and efficient in operation, with well regulated and ripple-free output, but should also possess self-protecting features. One of the most desirable features is over-current and short circuit protection. This type of protection can not only protect the power supply, but also (and usually more importantly) prevent costly damage and burnouts in the circuits to which power is supplied. In fact in most cases, overcurrent and the short circuit protection are essential characteristics of any good semiconductor power supply.

In this article, we will assume that the reader knows how to design a regulated power supply and hence will only discuss different techniques used to protect series-regulated power supplies against overcurrent and short circuit. Initially, a very simple series regulator is discussed and gradually other complex foldback types of power supplies are described.

The most common type of semiconductor power supply is the series voltage regulator. This type of regulator has many advantages over the other types and gives superior performance. Normally the load current in its entirety passes through the series pass transistor, which regulates the output voltage within very narrow limits of the designed value, irrespective of current level up to a predetermined maximum. If this current is exceeded, or a short circuit is applied to the output of the power supply, there is always a good chance that the series regulating transistor could be damaged permanently. If this transistor is big enough to withstand the overcurrent, then perhaps the rectifying diodes, or in some extreme cases power transformer might also suffer permanent damage.

A fuse, which is sometimes used for protection, is a relatively slow acting device and the semiconductors in the circuit are invariably damaged before the fuse gets any chance to act. This is because a normal fuse, unless it is semiconductor type, has a much higher thermal time constant than most semiconductors. From this it is quite apparent that protection of power supplies against short circuit and over current is something which has to be built into the design, using semiconductors only, so the protection action is fast enough for damage is prevented.

The output current and voltage characteristics most often found in series regulated DC semiconductor power supplies are shown in Fig. 1.

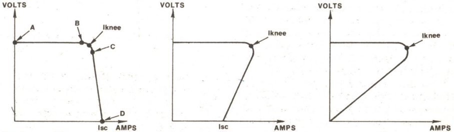

FIG. 1 (a) (b) (c)

Fig. 1a shows the operating characteristic of a power supply where from point A to B the supply operates as a constant voltage source. As the current increases from zero to some value Iknee, the output voltage remains constant. Any further increases in current, then causes it to change into a constant current source, and this section is shown by the curve from point C to point D. For the short circuit condition, the output voltage goes to zero and the short circuit current is limited to some value of Isc. The maximum current Iknee and the short circuit current Isc are under the control of the circuit designer.

In the short circuit condition, very high power is dissipated in the series pass transistor. The power dissipated is equal to the unregulated voltage at the input of the series transistor multiplied by the short circuit current Isc.

Fig. 1b shows another type of characteristic in which the output voltage remains constant until maximum current Iknee is reached. Any attempt to draw more current takes this type of regulator into a negative impedance region, where the current actually decreases, finally reaching some value Isc which is less than Iknee. As before the values of Isc and Iknee may be set by the designer.

The power dissipated across the pass transistor in the short circuit condition is again equal to the unregulated voltage at the input of the transistor multiplied by Isc. However the power dissipated in this case is less than that of the previous case, as here Isc is less than Iknee.

The ideal characteristic for a power supply is really that shown in Fig. 1c. In this type of regulator, as the current drawn from the power supply increases beyond Iknee, it enters into a negative impedance region where the current decreases right back to zero.

Thus at short circuit, the regulator actually turns off and supplies either no current, or negligible current to the load. Accordingly the power dissipated across the series transistor is almost nil, a most desirable situation. However, this type of regulator does not restart after removal of a short circuit and either needs a resetting arrangement or special design care to make it self starting.

The most simple type of series regulator circuit is shown in Fig. 2. where the components shown in the dashed block add current limit and

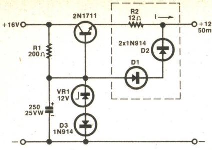

FIG. 2

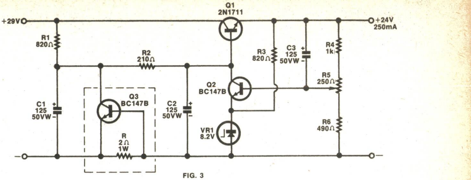

FIG. 3

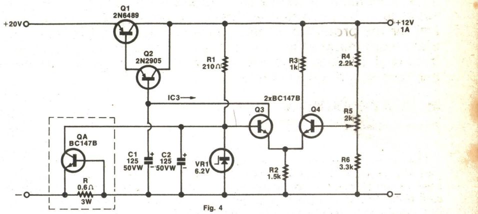

Fig. 4

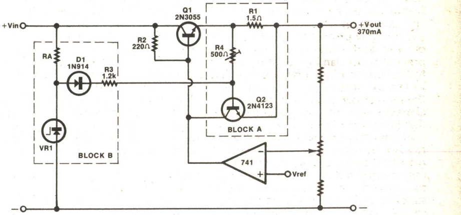

FIG. 5

hence short circuit protection. Without the components in the block, the regulator gives regulated output easily up to 100mA or more.

During normal operation, before the current limit section starts to play its part, transistor Q1 has its base-emitter junction forward biased and this keeps the transistor well inside the active region. The voltage drop across resistor R2 is negligible under these conditions. There is no current flow, or negligible current flow through diodes D1 and D2, so they do not affect operation.

As long as the current I is low and is less than Iknee, the drop across resistor R2 is very small. But when the current I starts to exceed the knee this drop increases and starts to back bias the base-emitter junction of Q1, gradually turning it off. At the same time diodes D1 and D2 start conducting. Here, diode D1 compensates for the drop across the base-emitter junction of the transistor and D2 takes care of the drop across resistor R2.

At total short circuit, the maximum current is approximately given by

$$0.6/R2 + (Vin - 1.2)/R1$$

This supply can remain short circuited indefinitely provided all the components are properly chosen for their power rating. The approximate equation for the maximum current at which regulation will hold good is given by I =0.6/R2. The regulator has the characteristic shown in Fig. 1a.

A simple feedback type of series regulator is shown in Fig. 3, where Q1 is the series regulating transistor and Q2 is an error amplifier that controls the conduction of Q1 to maintain the output voltage constant. As before, the addition of transistor Q3 and resistor R makes this circuit current limiting and short circuit protected. At low output currents, the drop across R is insufficient to forward bias Q3; hence Q3 is cut off and does not affect the normal regulating function. As the output current starts to increase from zero, due to feedback action, the output voltage is maintained constant; however, at a certain value of current, Iknee, the drop across R becomes sufficient to forward bias the base-emitter junction of Q3. As the current further increases, Q3 starts conducting more and more and in doing so, it diverts base current from Q1. This reduces the output voltage and at this point the regulator converts itself from constant voltage mode to constant current mode, to take the characteristics as shown in Fig. 1a.

During a short circuit, high power is dissipated in the series pass transistor Q1 and the current sensing resistor R. Hence this particular circuit, although it protects itself from short circuits, cannot withstand a short circuit condition indefinitely. The approximate value of the short circuit current is given by

$$Isc = 0.6/R.$$

Another feedback type of series regulator, using a PNP series pass transistor, is shown in Fig. 4. Here, as before, current limiting circuit is shown in the dashed block.

Interestingly enough, this particular regulator circuit can and does function to limit the output current without the components shown in the block. And the circuit is also short circuit protected. However, the maximum current Imax given out by the regulator depends on the current gains of transistors Q1 and Q2. Imax is equal to the maximum base current of transistor Q2 times the gains of transistors Q1 and Q2. The base current of Q2 is the same as the collector and emitter currents of Q3. Therefore, the maximum output current of the regulator, in absence of transistor QA is given by

$$Imax = \beta 1 \beta 2 \ (VR1 - 0.6)/R2$$

Under short circuit conditions the action of the regulator in Fig. 4, without transistor QA, is also self-protecting. When a short circuit is applied to the regulator the output voltage is reduced to zero, so there is no bias current through resistor R1 for the zener VR1. As the reference is reduced to zero, the regulator turns off.

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## PROTECTING SUPPLIES

By adding resistor R and transistor QA the current limiting action of the regulator becomes more predictable and totally independent of the gains of Q1 and Q2. Here, transistor QA is in cut off until the current Iknee is reached. When the current starts to increase beyond this critical value, transistor QA conducts and reduces the reference voltage of the regulator. The output voltage thus decreases.

Under short circuit conditions, QA goes fully into conduction to reduce the reference voltage to practically zero. As the reference goes to zero, the output voltage also goes to zero. The regulator operating characteristics are as shown by Fig. 1a. Again, here the approximate value of the short circuit current is given by

$$I_{sc} = 0.6/R$$

This circuit looks as if it is not self starting, because the reference operates from the output voltage. But capacitor CL gives it the self starting feature, by causing initial conduction of Q2 and Q1.

A circuit that uses the popular NPN type of series pass transistor is shown in Fig. 5. In this particular circuit current limiting and short circuit protection are not inherent, like that of Fig. 4, hence the components in the dotted block 'A' are necessary. With these components, the characteristic of the regulator is as shown in Fig. 1a.

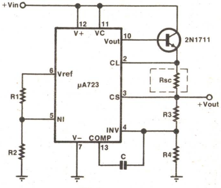

FIG. 6

However, if the additional components in block B are added to the regulator, the characteristic can be changed to that of Fig. 1b or Fig. 1c by simply varying resistor value RA. When the value of RA is a maximum the characteristic is as per Fig. 1c, while when RA is a minimum it changes to Fig. 1b. However when RA is maximum the circuit needs resetting and starts only when RA is reduced.

With the availability of voltage regulator ICs such as the popular 723 the design for overcurrent and short circuit protection has become very simple. The recommended circuit for a simple 723 voltage stabilizer is shown in

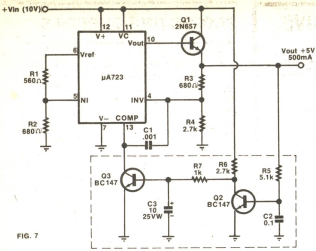

FIG. 7

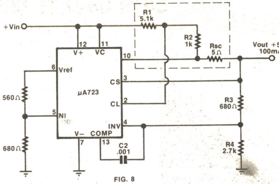

FIG. 8

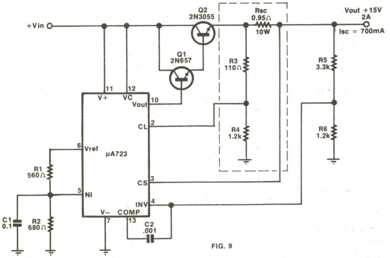

FIG. 9

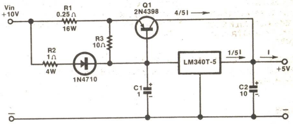

FIG. 10

Fig. 6, where R4 is to be removed for output voltages from 2 to 7 volts. Here resistor Rsc is used for current limiting action and the equation is given as Isc = Vsense/Rsc. For higher current outputs additional external transistors are required.

The circuit shown in the dashed area of Fig. 7 is useful for short circuit protection, although it does not give overcurrent protection. Under normal conditions, transistor Q2 is 'ON' and Q3 is 'OFF'. When the output is shorted, Q2 turns off and in turn switches Q3 on. Thus the base drive for series transistor Q1 is cut off by the IC, to reduce the output current to zero.

Initially, when the power is turned on, the collector of Q2 gets the supply slightly before the base of the same transistor. This could prevent the regulator from turning on, as Q3 would prevent base drive to Q1. This is prevented by the use of the delay network formed by R7 and C3.

As an alternative to standard current limiting techniques foldback current limiting, as shown in Fig. 1b, is an advantage in any power supply situation where the allowable output device power dissipation under short circuit conditions is restricted due to device and/or heatsink limitations. This is especially true for high current regulators. A minimum parts method for doing this with a 723 regulator is shown in the dashed block of Fig. 8. Here three resistors provide the positive feedback necessary for foldback action. This technique introduces positive feedback by the increased current flow through the R1-R2 leg under short circuit conditions. Short circuiting the output causes the circuit to latch up. Reset is achieved by turning the power supply off and then on again to restore normal operation, after the short is removed.

Another method of providing foldback current limiting is shown in Fig. 9, in which the base of the current limit transistor in the 723 is fed from potential divider R3-R4 as shown in the dashed block. With this circuit there is a restriction on obtaining very low short circuit currents, whereas the previous circuit is designed to give approximately zero short circuit current. However this circuit has automatic restart and no resetting is necessary.

The foldback circuit will severely limit the knee current if the difference between Vin and Vout is small. This problem is accentuated by the relatively large value of Rsc, which develops a considerable voltage drop at Iknee and worsens the load regulation. The voltage drop in Rsc is in addition to the minimum voltage drop normally allowed between Vin and Vout. Since R3 and R4 both must be positive it can be proved that the minimum ratio of Isc to Iknee is

$$\frac{\mathrm{Isc}}{\mathrm{Iknee}} \geqslant \frac{\mathrm{Vs}}{\mathrm{Vout} + \mathrm{Vs}}$$

where

Vout = regulated output voltage

Vs = turn-on voltage for the current limit transistor (0.6V)

One last circuit that should be considered is shown in Fig. 10, where a three-terminal LM340T-5 IC regulator is used. This IC regulator chip by itself gives a fixed output of +5V with maximum output current of 1.8 amp. It has built-in over current and short circuit protection.

The current from the chip may be increased by adding the circuitry shown. Here the ratio of R2 to R1 gives the approximate current ratio of transistor current to IC current. In this case it is 4amp to 1amp. Under short circuit condition maximum current through the circuit is 9 amps, out of which 1.8 amps comes from the IC and 7.2 amps come from the current boosting transistor.

The full current limiting and protection capabilities of the regulator IC are retained in this circuit at the higher current levels, because the IC's input current constitutes the current drive for the base of Q1. Hence when the IC throttles itself back under overload conditions, it also throttles back Q1.

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What you will need to make it is six or more of the little push-on push-off switches which are commonly used on table lamps and bedlamps. As the diagram shows, these are wired in series with a couple of torch cells and an ordinary torch lamp. When all the switches are in the "on" position, the lamp will light. When any one switch is in the off position, the lamp will remain stubbornly off, no matter how much the remaining switches are operated.

To give the gadget an identity, components need to be assembled into some kind of a box, with the switches and the lamp in a line on the top and the batteries inside.

The size, style and finish of the box are left to you but it isn't a bad idea to have the name INFURIATOR on the top.

The idea is to invite your friends to manipulate the switches until the light comes on.

The annoying thing about the switches is that you can never tell, by looking at them, whether they are on or off, or whether you did or did not push them a moment ago.

This makes it particularly difficult to work through the combinations in a systematic manner; the person who fails to get the lamp on is annoyed to realise that he is pushing them in a completely random way and may just miss out repeatedly on the one correct combination.

And, if he does strike it, he knows that it was a matter of luck and he can't be sure to repeat the process.

Six switches would appear to be about the optimum number to use. Fewer than that, and the gadget isn't sufficiently infuriating. Seven or eight switches will increase its "infuriation factor" but will also make it harder for the owner to obtain the desired result in reasonable time.

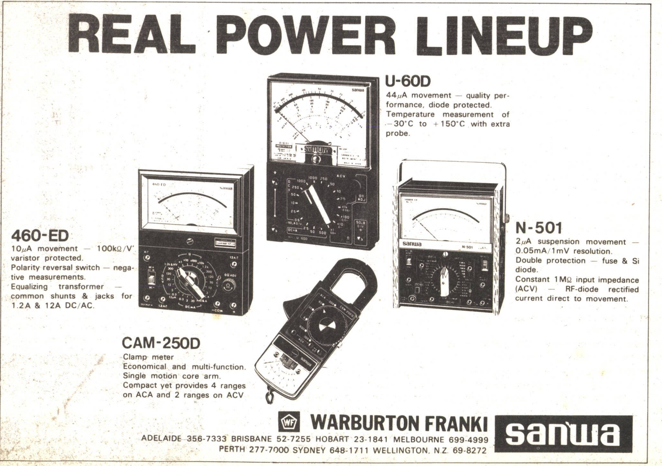
The number of possible combinations is equal to 2 raised to the same power at the number of switches. With 6 switches, the combinations add up to 2 to the power 6, which is 64. Another switch raises the figure to 128 and still another to 256.

Well then, how can one work systematically through the combinations without missing moves or duplicating them?

The answer: By treating the switches as if they were part of a binary counting system — the basis on which calculators and computers operate.

But don't tell your friends what you are up to or they will get on to the binary approach too. Then you are the one who will be infuriated!

If you know nothing about the binary system, this is a good opportunity to learn something about it. Whereas the



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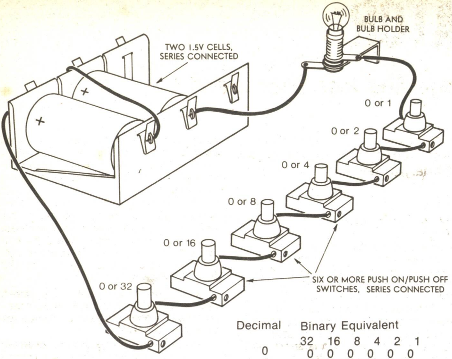

columns in the decimal system increase (to the left) by a factor of ten — units, tens, hundreds etc — the columns in the binary system increase by a factor of two — one, two, four, eight etc.

There are only ever two figures in a binary column; 0 or 1. The "0" is self explanatory, while the "1" represents the value assigned to that column. Thus a "1" in the four column, represents 4; a "1" in the eight column represents 8; and a "1" in both columns represents 12.

On this basis the switches can be mentally allotted column values as shown in the wiring diagram. The switch on the right has the possible values of either 0 or 1, next is either 0 or 2, the next 0 or 4, the next 0 or 8, and so on.

As the table of binary numbers show, 6 binary columns provide a code with which you can work through the 64 possible switch positions without forgetting any.

If the lamp is out and people have been randomly pushing switches, no one can know which ones are on and which ones are off. But don't worry. You simply assume that ALL switches are off and you work through the binary series from decimal 0 (binary 000000) to decimal 63 (binary 111111) and you must strike the combination that will light the lamp.

First push the right hand switch and your binary count is decimal 1.

To get decimal 2, press 1 again to bring it back to 0, then press switch 2.

To get decimal 3, press switch 1 again to re-introduce your 1 (binary 000011).

To get decimal 4, press switches 1 and 2 to bring them back to 0 and press switch 4 (binary 000100).

| Decimal | Binary Equivalent | | | | | |
|---|---|---|---|---|---|---|
| | 32 | 16 | 8 | 4 | 2 | 1 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 2 | 0 | 0 | 0 | 0 | 1 | 0 |
| 3 | 0 | 0 | 0 | 0 | 1 | 1 |
| 4 | 0 | 0 | 0 | 1 | 0 | 0 |
| 5 | 0 | 0 | 0 | 1 | 0 | 1 |
| 6 | 0 | 0 | 0 | 1 | 1 | 0 |
| 7 | 0 | 0 | 0 | 1 | 1 | 1 |
| 8 | 0 | 0 | 1 | 0 | 0 | 0 |
| 9 | 0 | 0 | 1 | 0 | 0 | 1 |
| 10 | 0 | 0 | 1 | 0 | 1 | 0 |

A few larger numbers in the series are shown below as examples.

| | | | | | | |
|---|---|---|---|---|---|---|
| 15 | 0 | 0 | 1 | 1 | 1 | 1 |
| 23 | 0 | 1 | 0 | 1 | 1 | 1 |
| 41 | 1 | 0 | 1 | 0 | 0 | 1 |
| 63 | 1 | 1 | 1 | 1 | 1 | 1 |

To get decimal 5, press switch 1 again to add a 1 to the 4 obtained in the last step. And so on through the series.

Even if you are interrupted while doing the sequence, you can go back and continue as long as you remember the number at which you stopped. If you stopped at 23, for example, you must have had switches 16, 4, 2 and 1 pushed on. So you simply return 4, 2 and 1 to the zero state and press switch 8 to get a total of 24.

You would be extremely unlucky to have to go right through the series to 63.

It requires a certain amount of concentration to work accurately through the numbers, but it isn't all that hard.

In fact, with a little more concentration you can economise in switch operations.

If you press switches 1, then 2, then 1 again, you have covered decimals 1, 3 and 2 in that order. Now press switches 4, 1, 2, 1 in that order and you will have covered decimals 6, 7, 5 and 4. Other routines are possible and you may come up with one which you consider easier to remember.

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For the handyman/experimenter:

# A Frame Aerial & Tuner

This simple rather odd looking gadget has several novel applications. It can boost the performance of small portable radios, illustrate the elementary principles of direction finding, and form the basis of a simple crystal set for use with an amplifier or tape recorder.

To give the gadget a name, old-timers in the radio game would call it a "frame aerial". To it we will add a couple of other components, to extend its uses.

Besides illustrating certain fundamental principles:

- It can boost the long-distance performance of simple portable receivers.
- It can provide a radio signal for your tape recorder or amplifier.
- It can work as a self-contained crystal set, operating a pair of headphones.

The prototype was built from scraps of particle board, as per Fig. 1. Plywood or other non-metallic material could be used but particle board (eg Pyneboard) is readily available and simple to work.

The dimensions are quite arbitrary but, if you work to those shown, your unit should operate in a manner similar to the original, without need for modification.

Lay the pieces of particle board on the table so that you can judge the angles and file them as necessary with a wood rasp. Put a smear of glue between the surfaces and use some long, slender panel pins to hold the pieces together. Let the glue dry, if you like, but the frame should be rigid enough, with the pins in position, to carry right on with the construction.

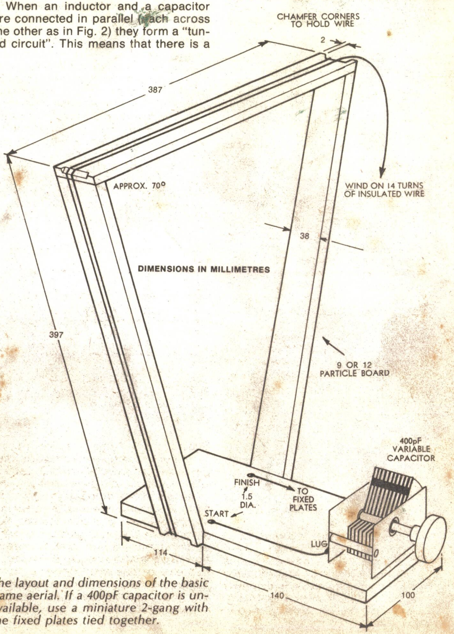
Wire has to be wound around the frame and, to keep it in position, all four corners should be chamfered with a rasp or sharp knife, leaving just the outer edges raised.

You will need about 20 yards (18.3m) of thin, insulated wire. The gauge and age of the wire is not important, provided the insulation is good. We used single-strand plastic insulated "bell-wire" bought from a hardware store.

Pass one end through a hole in the base-board and, keeping the wire reasonably taut and straight, wind on 14 turns, laying the turns neatly side by side. Pass the free end through a second small hole in the base-board and the first part of the job is done.

Using electronics terminology, you have wound a type of "coil" or "inductor". On its own, an inductor is not particularly useful for our present purposes. It needs to be associated with another electronic device known as a "capacitor". Old timers used to call it a "condenser".

When an inductor and a capacitor are connected in parallel (each across the other as in Fig. 2) they form a "tuned circuit". This means that there is a particular frequency of alternating voltage or current, to which the combination is most responsive. If energy at this frequency induced ie, (introduced) into the tuned circuit, it will oscillate (or



*The layout and dimensions of the basic frame aerial. If a 400pF capacitor is unavailable, use a miniature 2-gang with the fixed plates tied together.*

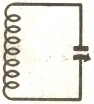
flow back and forth) between the inductor and the capacitor with the greatest facility.

By selecting suitable values for the inductor and the capacitor, a tuned circuit can be "resonated" (or made responsive) to any desired frequency. If either one is made variable, the "resonant" frequency will vary in accordance with it.

By having a suitable fixed inductor and a suitable variable capacitor, a tuned circuit can be made to respond to any frequency radiated by normal broadcasting stations within the frequency band of 525kHz (kilohertz) to 1600kHz.

To tune right across the ordinary radio broadcast band, you will need a variable capacitance having a maximum capicatance of about .0004 microfarads or 400 picafarads (pF).

Fortunately, the majority of variable capacitors that have been used in older broadcast band receivers have a maximum capacitance of about this value. You shouldn't have too much trouble in getting hold of an old one or a new one, though you may need to ask your local radio serviceman, or soneone who knows about such things, to verify that it is suitable.



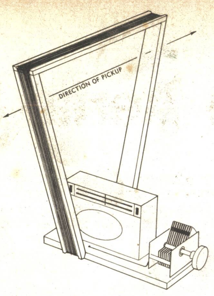
*The schematic diagram for a resonant (or tuned) circuit. The inductor (or coil) is on the left; the capacitor (or condenser) is on the right.*

While you are at it, ask them to verify for you the two connections you will need to make, one to the moving plates (usually via the frame) and one to the fixed plates.

Mount it on the baseboard of your frame inductor, connect one end of the inductor to the moving plates, and the other to the fixed plates and the combination wll have become a complete tuned circuit.

The tuning coils in radio receivers are normally quite small — most would fit easily in a thimble — and, for this reason, they cannot directly pick up much in the way of signal from a radio station. Consequently, many radio receivers have provision for the connection of an aerial wire, and perhaps an earth wire, by which signals are fed to the first tuned circuit.

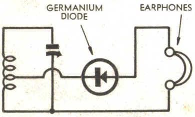
In portable receivers an alternative method is used, the first tuning coil being wound on a ferrite rod a few inches long. Energy from radio stations tends to concentrate in the rod and therefore in the coil which is wound around it. This provides enough signal pickup in areas not too remote from the broadcasting stations.



*A frame aerial has obvious directional qualities. To get an accurate bearing on a distant transmitter, the frame aerial needs to be in the open, away from house wiring, metal roofing, etc.*

Because of its size, the frame aerial that you have just finished can also pick up signals directly. In fact, it will pick up signals rather better than the ferrite rod system in the more compact transistor portables. As a result, it can be used to assist very small portables to pick up weak and distant stations.

Frame aerials have directional qualities. They will pick up signals most effectively when they are positioned edge-on to the station. They show a deep null — or lack of pickup — from directions broadside on to the frame.



*Above: The simple crystal set hook-up. Right: A slightly more complicated circuit suitable for use as a tuner or with a crystal earpiece.*

In fact, radio direction-finding devices make use of this fact. By selecting a particular radio station and rotating a frame (or loop) type aerial so that the signal is rejected, the operator knows that the particular station lies along a line at right angles to the plane of the frame. Some doubt remains because the station could lie — say — due east or due west. However, other factors are usually sufficient to resolve this ambiguity. For example, if a boat is cruising off the east coast of Australia, all Australian radio stations would have to be in a generally western direction.

It so happens that the ferrite rod aerials used in transistor portable receivers are also directional. They also tend to exhibit a null when the coil is broadside on to the transmitting site; this corresponds to the position when the ferrite rod through the coil is end-on to the transmitter.

To use your frame aerial to boost the signal pickup of a small set, rest the set on the base of the device so that its internal ferrite rod is at right-angles to the plane of the frame. (See Fig. 3) Rotate the frame so that it is edge-on to the direction of some distant, wanted station. Switch the set on and tune to the particular station.

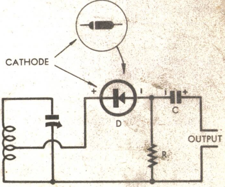
Now rotate the tuning capacitor of your frame aerial and, at a particular point, you should hear the volume from the wanted signal increase. Tune the frame carefully and rotate it as necessary until you get the best result.

But it is essential to tune the capacitor carefully. If it is tuned to either side of the proper frequency, it may boost a nearby unwanted station and overpower your receiver's tuning circuits.

What is happening, under these conditions, is that the relatively large frame aerial is picking up a greater amount of signal and concentrating it inside the area of the loop.

Here it is coupled into the ferrite rod of the receiver and passed into the tiny coil wound around the ferrite rod.

Fig. 4 is the circuit of an elementary crystal receiver using the tuned frame aerial, a germanium diode and a pair of headphones. The frame aerial is shown as a coil on the left of the diagram.



Although the diode is drawn in a particular way, in the elementary circuit of Fig. 4 it really does not matter to the end result which way round it is connected. However, make sure to ask for a "germanium diode for use as a detector". The types most commonly available would appear to be OA90 and OA91. Older types which would nevertheless be entirely satisfactory include the OA70, OA71, OA80, OA85 and IN34.

The headphones, ideally, should be of the now old-fashioned type,

# Frame Aerial & Tuner — continued

sometimes branded "High Impedance", sometimes marked with an impedance value typically between 2000 and 4000 ohms. You may be able to beg or borrow a pair from an old-timer who has no further use for them, or you may be able to pick up medium impedance phones from a military disposals store. (At the time of writing, ex-disposals headphones are available from A.C.E. Radio, 136 Victoria Rd, Marrickville, NSW 2204. Price $3.00 plus P&P $1.00 in NSW, $1.75 elsewhere).

Note that the detector is shown connected to a tapping only part way up the coil. This is usually necessary to prevent the detector and earphone circuit from loading the tuned circuit too heavily and so reducing its "selectivity" that it is unable to separate the stations clearly.

While the arrangement of Fig. 4 will work with ordinary headphones, the circuit we suggest in Fig. 5 is slightly more complicated but more universal in its application.

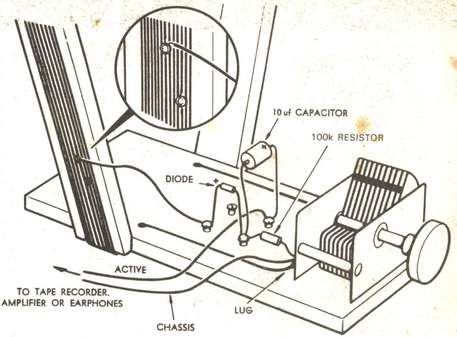
In this circuit it is necessary connect the diode with the cathode end towards the coil. The cathode end is usually denoted by a band of colour around the glass or the epoxy moulding. In some types the cathode lead is distinguished by being a softer wire than is used for the anode lead.

The resistor "R" is not critical and anything between about 47k and 150k would do. We used a 100k (100,000 ohms or 0.1 megohm). Wattage rating is unimportant and the resistor can be connected either way round.

The capacitor is an electrolytic type which can have a capacitance rating anywhere between 1 and 25 microfarads, and a voltage rating anywhere between about 6 and 25 volts. Its plus end may be denoted by a plus sign or a red spot. Alternatively, there may be a minus sign or black stripe to indicate the negative end. Connect it as shown.

As with the simpler circuit, this one can be used as a self-contained crystal set by connecting ordinary high or medium impedance headphones to the two leads marked "output". If you are unable to purchase phones of this kind, or you wish to avoid spending a lot of money, the set will work in the stronger signal areas with a simple crystal earpiece which can be bought for about 70c. Note that "low impedance" magnetic earpieces will not work at all well in a simple set like this.

While the frame aerial crystal set can be used as a completely self-contained receiver, it can also be used as a radio tuner in conjunction with an amplifier or a tape recorder. How well it will work in this role depends to a large extent on the location in which it is used but in urban areas within, say, 10 miles of the broadcasting stations it can perform very well indeed.



*The complete receiver, ready to connect to headphones or an amplifier.*

The wire connecting to the bottom of the coil (as drawn), to resistor "R" and to the frame of the tuning capacitor can connect to the chassis or metal work of the amplifier or tape recorder. The other wire can connect to the active input sometimes marked "Radio", or "Pickup" or "Auxiliary". It could be tried in the "Microphone" input but there is a possibility that the signal level from the tuner might be high enough to cause distortion.

In many cases, the connection to the amplifier or tape recorder can be made with a couple of scraps of wire twisted together. However, if a plain wire connection causes hum in the amplifier or recorder, use a short length of shielded wire and the proper plug to suit the amplifier or recorder, if such is required. Use the braid as the "earthy" circuit connecting to the metalwork, and the inner lead as the "hot" signal lead.

Fig. 6 shows how the additional components are added to the frame aerial. We obtained some small brass screws from a hardware store, polished the heads with a file and then screwed them part way into the particle board to provide anchor points for the components. This done, you can "tin" the heads of the screws with solder.

Now take each of the small components and grip each of the leads in turn close to the body of the component in the tip of pointed pliers. Bend the rest of the lead down so that it will be able to bridge between the necessary screw heads. Now grip each lead in turn with the pliers and tin the end with solder. Finally, still holding the leads with pliers, spot them in the appropriate places.

Using pliers to bend the leads avoids placing a strain between the lead and the tinny body of the component. Holding the lead with pliers while you solder helps to prevent the excessive heat reaching the component from the soldered joint.

Finally, there's the matter of the tapping on the frame aerial. This, too, can be made with the aid of brass screws. Push the wires aside slightly and drive a screw about half-way in, just under where turn 3 passes; put another screw under where turn 6 passes. Carefully scrape away about ¼-inch of the insulation and drop the turns into the head slot of the respective screws.

Now wedge or hold the adjacent turns away from the screws so that the insulation will not melt and solder turn 3 and turn 6 to the heads.

The tapping which will give the best results can be selected by trial and error. Turn 6 will tend to give louder signals but poorer selectivity. Turn 3 will give better selectivity but weaker signals.

In fact, there is no reason why you can't make additional tappings and experiment to your heart's content.

One more thing: If you need more signal, try connecting an outside aerial to one of the tappings and an earth to the end of the coil connecting to the frame of the tuning capacitor.

HINT: You can use the frame as an external aerial by connecting the three turns between the end and tapping respectively to the receiver's earth and aerial terminals. Point the frame towards the station you want and tune the capacitor for greatest signal strength.

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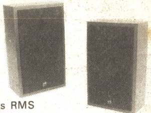

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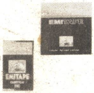

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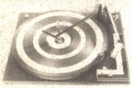

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PRACTICAL ELECTRONICS

# The tools needed for project building

*A few basic tools are necessary before you can build your first electronic project. But which tools should you buy? In this chapter we take a look at the tools you will need to get started in hobby electronics, and explain how they are used.*

**by GREG SWAIN**

As with any other hobby, it does cost some money to get started in electronics. But don't be intimidated. Very few tools are required for basic project work, and the overall cost of these can be quite modest.

In fact; some of the tools required may already be on hand in the family tool box.

Let's assume that you're starting from scratch, though. As a bare minimum you will require the following:

- soldering iron
- set of screwdrivers
- long nose pliers
- side cutters
- wire strippers

These tools are illustrated in the accompanying photograph and, with the exception of the soldering iron, are from the well known Xcelite range. They are all you need to assemble many electronic projects, particularly those where the metalwork or case comes pre-drilled.

## The soldering iron

The most expensive item will be the soldering iron. This should have a rating of between 10 and 25 watts, and may be either a mains operated type or a low voltage type operated from a transformer. There is no set preference for either.

So how do you choose which type best suits your requirements?

To some extent, it all boils down to a matter of personal preference. The low voltage types generally have the advantage of being smaller and lighter than equivalent mains types, and are often preferred for this reason. Another advantage is that the accompanying transformer includes an in-built rest to hold the iron when it is not being used.

The main disadvantage of a low voltage iron is the fact that you do need the transformer. It is an expensive item, often costing more than the iron it is to power. Taken together, the two items will cost roughly twice as much as an equivalent mains-powered soldering iron.

If you want to save money then, the mains-operated type is the one to go for. The latest types are quite light and compact, although they would tend to be a little more tiring on long jobs than the low voltage types.

Another type of soldering iron which you might like to consider is the controlled temperature type. While a very light 10W iron of the simple type is OK for soldering ICs and component leads to a PC board, it will not be suitable for heavy duty work. Temperature controlled irons, on the other hand, provide the option of a relatively small tip for light duty work, and yet have sufficient power for heavy duty jobs.

As with the simpler uncontrolled types, controlled temperature soldering irons can be either mains or transformer operated. Their higher cost makes them hard to justify at hobby level, however, unless the iron is to be used for a variety of jobs.

So you see the choice is really up to you. Simply choose the soldering iron that best suits your requirements and your budget. Typical soldering irons suitable for general purpose hobby work are marketed under such brand names as: Mico, Scope, Weller, Adcola and Lotring.

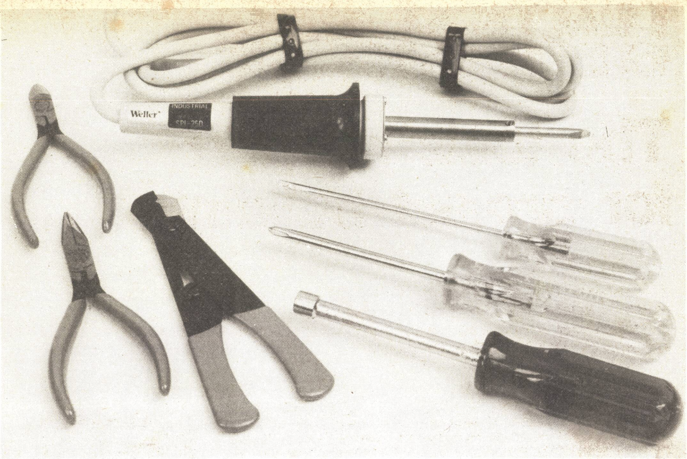
*This Weller-Xcelite tool kit contains a soldering iron and all the tools you'll need to get started.*

One word of warning though! It's best not to get an iron with a carbon element. Sooner or later you'll want to solder CMOS integrated circuits, and the heavy currents flowing from the carbon element to the copper tip of this type of iron present a potential hazard for these devices.

OK, that covers the soldering iron. What about the other tools?

## Screwdrivers

A set of four or five blade screwdrivers with blade widths ranging from 2mm up to 10mm should suffice for most project work. The 2mm size will



*Buy the tools separately if you prefer. Included here are side cutters, long nose pliers, wire strippers, a nut runner, Phillips head and blade screwdrivers, and a 25W soldering iron.*

be useful for getting at the small grub screws used to secure a wide range of front panel knobs, while at the other end of the scale the 10mm size will come in handy for such jobs as securing transformer mounting screws.

What is important here is that you should always use the correct screwdriver for the job. The blade should be a snug fit into the slot and should be approximately the same width as the diameter of the screw head.

If you use a screwdriver that's too small, its blade will twist in the slot. This can cause damage to both the screw head and the screwdriver itself.

## Long nose pliers & side cutters

Long nose pliers and side cutters (also called diagonal cutters) are tools that you will use quite frequently, so make sure that the tools you buy are well made and comfortable to hold. Those with box joints are usually the strongest, while plastic grips on the handles can be a great aid to comfort.

Both tools are available in various sizes. The best size for general purpose hobby work is around 150mm in length.

Strictly speaking, a pair of wire strippers is not really necessary. It's quite possible to strip wire insulation using a razor blade or a small pocket knife. You do, however, run the risk of cutting into and damaging the wire conductors with this method.

The best advice is to buy a pair of wire strippers. Their cost is quite modest and they will do the job faster and neater than alternative methods. Another possibility here is to buy a combination wire stripping and side cutting tool.

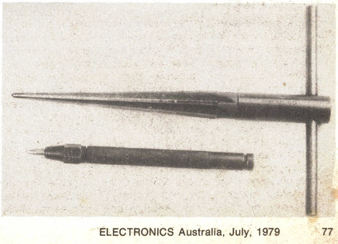
Those are all the basic tools you will need to get started in electronics. Not very many, are there?

Of course as one progresses in electronics, other tools become desirable. The serious electronics enthusiast eventually ends up with quite a collection of tools, and can tackle anything from metalwork to loudspeaker cabinets.

## Second line purchases

Typical second line purchases will include: an electric drill, drill bits, centre punch, Phillips screwdrivers, nutdrivers (also called spintites), nibbling tool, hacksaw, tapered hand reamer, a small hammer, vyce, files, steel rule and scriber. All these tools are extremely useful, especially for working on instrument cases and metal chassis.

Let's take a look at some of these



*Two useful metalworking tools: a 3-12mm tapered reamer (top), and a centre punch.*

tools and see how they are used. First up, some tips on buying an electric drill.

The electric drill you buy should be double insulated, have a 10mm capacity chuck, and preferably have two speeds. The mechanical speed control types are generally more powerful than the electronically controlled types, but are also more expensive. Keep in mind, too, that an electric drill is handy for other jobs around the home, so buy accordingly.

Buy a very good set of twist drills to go with your electric drill. A comprehensive set ranging in size from 1.5mm to 6mm will do for a start. Don't buy cheap drills; they won't last long and are quick to blunt.

An electric drill is not difficult to use, provided a few basic points are observed. When drilling in metal, for example, it is always a good idea to centre punch the position of the hole first. A centre punch is a small cylindrical tool with a hardened steel point.

If you don't centre punch the hole position first you will find that the drill tends to wander when starting. When the drill does "bite" it will probably be not quite in the right place, and the resulting hole will be off-centre.

When using an electric drill to drill a large hole it is also a good idea to drill a small pilot hole first. You'll be able to position the hole much more accurately if you do. As a bonus, your drills will last longer. Deburr all holes using an oversize drill bit, either fitted to a hand drill or twisted with your fingers.

*An 11-piece set of nutdrivers (spintites) from the Xcelite tool company.*

Most of the screws you come across will be of the familiar slotted head variety. Sooner or later though, you're going to come across Phillips head (or crosshead) screws, which require the use of specially designed screwdrivers. As you might expect, these are called Phillips screwdrivers, and a set of five or six will make a valuable addition to your tool collection.

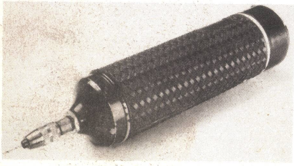
## Nibbling tool

OK, so what's a nibbling tool? Well, you can see what one looks like by referring to the photograph. It's a tool for producing cutouts of any shape in sheet metal panels. As its name implies, it lets you "nibble" away the metal piece by piece until the desired cutout is achieved.

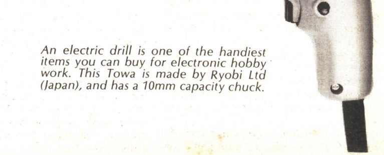
Before the tool can be used, a pilot hole large enough to clear the cutting head must first be made within the cutout area, using a drill and hand reamer. The head of the tool is then inserted through the hole, the metal edge inserted into the cutter, and the handles of the tool squeezed together to make the cut. The cutting head is then advanced to cut out the next piece of metal.

The way in which the tool is used is shown in one of the photographs.

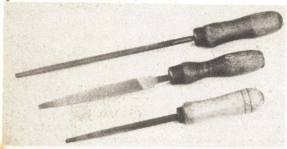
A hacksaw is useful for cutting



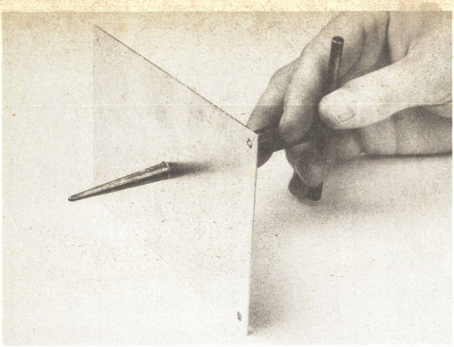
*Left: this small battery-powered drill is especially useful for drilling holes in printed circuit (PC) boards. Suitable drill sizes for PC work are 0.8mm and 1mm.*

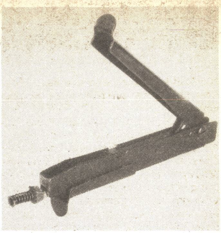


*An electric drill is one of the handiest items you can buy for electronic hobby work. This Towa is made by Ryobi Ltd (Japan), and has a 10mm capacity chuck.*

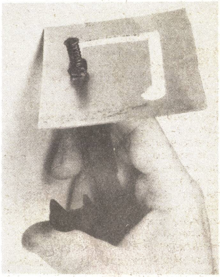


*This file set includes round, flat and triangular files.*





*A nibbling tool is used for making cutouts in sheet metal panels.*



**The tools in action:** *reamer (top), nibbling tool (right).*

aluminium, plastic and a wide range of other materials. It's a fairly simple tool to use, provided you adopt the correct technique. The blade should be inserted with the teeth facing forwards (away from the handle) and tightened until it gives a definite "ping" when plucked with the finger. A dull "thung" means that the blade is too loose.

Use a fine-toothed blade when cutting thin aluminium or plastic sheeting, to obtain a reasonably smooth finish. A coarser blade should be used for thicker materials.

### Hand reamer

Another tool likely to be unfamiliar to many is the hand reamer. This features a number of tapered steel cutting edges, and is mainly used for enlarging holes in plastic and sheet aluminium. For large holes, a reamer can give a much neater and more accurately positioned hole than an equivalent size drill.

Make sure that the reamer you buy has a gentle taper, similar to the one shown in the photograph. The ideal reamer for electronics work tapers from 3mm up to 12mm, and has an overall length of 140mm. Another popular size has a taper from 4mm to 22mm.

A reamer is used by first drilling a small clearance hole. The tip of the reamer is inserted into the hole, and the tool then turned in a clockwise direction until the hole reaches the required size.

Make sure that you always turn the reamer in a clockwise direction. Turning it anti-clockwise will blunt the cutting edges.

There's one important item that we haven't even yet mentioned — the multimeter. A multimeter is a piece of test equipment which performs voltage, current and resistance measurements on electronic circuits and components, and is an essential item for the hobbyist. It can carry out all the basic checks required in building and, if necessary, troubleshooting electronic projects.

We'll deal with the multimeter in greater detail in a later chapter.

We could go on and list many other tools, but these tend to be more specialised and are seldom used by the hobbyist. Included in this general category are such items as Allen keys, plastic alignment tools, scissor clamps, rivet guns, crimping tools, chassis punches and hole cutters.

The important thing to remember is don't go overboard when buying tools. Buy each tool only as you need it, not because you think you might be able to use it. A tool that is never used is a waste of money.

Finally some good advice. Always use the right tool for the right job. Use the wrong tool, and you run the risk of damaging both the tool and the component.

Don't skimp when buying tools. Buy the very best that you can afford and look after them. A shadow board or a tool box is a good idea. That way, your tools won't become lost and you'll be able to use them for many years to come.

*Large holes in metal work are easy with a chassis punch set.*

FOOTNOTE: Xcelite tools are sold by Radio Despatch Service, 869 George St, Sydney 2000, and from other outlets. Other reputable brands are available, and information on these will be available from tool stockists and electronics retailers.

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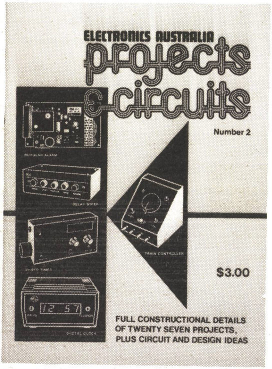

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# ADAPTABOX

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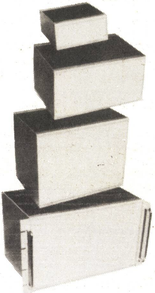

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***(1) The front and rear panels can be replaced with 3.0mm satin anodixed aluminium;***
***(2) The bottom panel can be replaced with 3.0mm satin anodised aluminium.***
***(3) Side panels can be of the rack mounting type, and with this option handles are also provided.***

Cases are suitable for mounting PCBs, Transformers, etc.

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**RADIO PARTS GROUP,** 562 Spencer St, West Melbourne (Tel: (03) 329 7888), 1103 Dandenong Rd, East Malvern (Tel: (03) 211 8122.
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# TI teaching system uses 16-bit CPU

**Just released in Australia, the Texas Instruments TM990/189 single-board microcomputer is intended primarily for teaching in colleges, universities and industry. It comes with comprehensive manuals, and can be used either with or without an external terminal. Of particular interest is the microprocessor it uses, which is a 40-pin version of TI's powerful 16-bit TMS9900 processor.**

### by JAMIESON ROWE

Superficially, the TM990/189 looks much the same as other single-board microcomputer systems intended for teaching and evaluation. It comes as a 280 x 207mm PCB which is provided with rubber feet on the underside, and obviously meant to be used "naked". But it doesn't take long to find out that there's more to the system than meets the eye.

Like other small systems, it has an on-board keyboard and LED display. In this case they are provided in the form of a modified "top half" from one of TI's calculators, giving the keyboard no less than 45 keys. One of these is used as a shift key, so that the total number of key functions available is no less than 88, of which 63 are actually used.

TI has taken advantage of the keyboard by using it for full alphanumeric intput. This means that they also have to use the LED display for alphanumerics — despite the fact that the LEDs are only 7-segment calculator readouts. So some of the characters look a little weird (K, M, R, V and W, for example!), while the others jump from upper to lower case and back again as you go along. But you get used to them after a while, and it does save money.

A circular piezoelectric audio indicator on the board next to the display gives the system the ability to attract the user's attention.

The next thing you discover upon reading through the user manual is that the system has an audio cassette interface on board, complete with optional motor control for the recorder. The interface uses the two tone FSK method, with tones of 1200 and 2400Hz — which should make it at least nominally compatible with systems using the "Kansas City/Byte" standard.

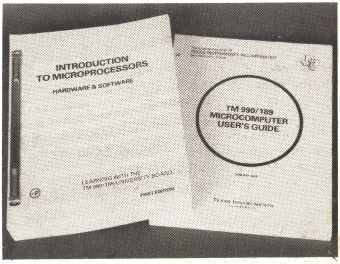
On the memory side, the system comes with 1K bytes of RAM which may be expanded to 2K bytes by merely plugging in another pair of chips. It also comes with 4K bytes of ROM, and this contains a resident monitor/debug program called UNIBUG.

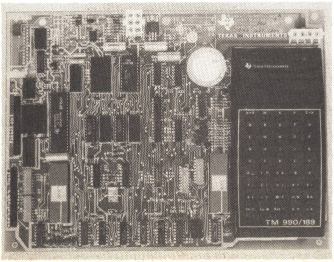
Along with the monitor, the ROM also contains — wait for it — a symbolic assembler! Not a full-scale multipass assembler with all the frills, to be sure, but a very useful little interactive assembler none the less. It offers the ability to use both forward — and backward — referenced labels, a current location symbol, and six pseudo-op directives: ORG, BSS (reserve a block of memory), DATA, EQU, TEXT (ASCII string storage) and END.

Needless to say this makes the TM990/189 much more attractive than earlier single board systems, which you had to program in hex. It is far easier, faster and more convenient to be able to program in symbolic language, whether you're learning or using the system for development work.

Incidentally you aren't limited to using the assembler with the on-board keyboard and display, either. Both the assembler and the monitor have routines for communicating with a normal external terminal; all you need to do this is wire up the appropriate hardware option on the board.

Only a couple of ICs and a few other parts are required to wire up the serial interface option, and you can configure it for either RS232C or 20mA current loop. The firmware driver routines work at either 110 or 300baud, as required.


INTRODUCTION TO MICROPROCESSORS
HARDWARE & SOFTWARE
LEARNING WITH THE TM 990/189 UNIVERSITY BOARD
FIRST EDITION
TEXAS INSTRUMENTS INCORPORATED
TM 990/189 MICROCOMPUTER USER'S GUIDE
TEXAS INSTRUMENTS



*At left is the complete TM990/189 training system — note the keyboard/display using converted calculator hardware. The two training manuals which accompany the system are shown above.*

# COMPUTER COMPONENTS

## MOTOROLA 6800 D2 EXORciser BUS Compatible Products

### 16K MEMORY BOARD uses 2114 ICs

**Kit complete except for 2114 ICs . . . . . . . . . . . . . . . . $97.50**

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- Electronics Australia Aug. 1978.
- 16 lines 32 characters.
- Memory mapped — software controlled

PCB epoxy glass gold contacts **$14.50**
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### MOTOROLA BUS MOTHER BOARD • 9 SLOT

**See E.A. Feb 1979 for full details of this board.**

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Built and tested . . . . . . . . . . **$99.00**

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- **Designed for wire wrapping or direct soldering** . . . . . . . . . . **$24.50**

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| 8086 | 150.00 | 8282 | 8.90 |
| 8212 | 4.15 | 8286 | 8.90 |
| 8214 | 7.40 | 8287 | 8.90 |
| 8216 | 3.40 | **6800 SYSTEM** | |
| 8224 | 6.15 | 6800 | 8.93 |
| 8226 | 3.40 | 6802 | 14.05 |
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| 8215A | 9.80 | 6821 | 6.50 |
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All above board prices include manuals. Manuals available for $5.00 — refundable when board purchased.

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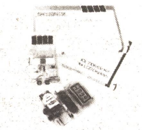

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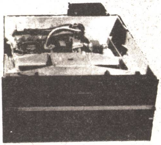

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| 20 PIN | 30 | 33 | 37 |
| 22 PIN | 35 | 39 | 43 |
| 24 PIN | 40 | 44 | 48 |
| 28 PIN | 45 | 50 | 56 |
| 40 PIN | 55 | 60 | 63 |
| 60 PIN | 95 | 1-10 | 1-35 |

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| 10,000MFD | 25V | 8.00 EA. |
| 15,000MFD | 25V | 9.50 EA. |
| 22,000MFD | 25V | 10.50 EA. |
| 68,000MFD | 16V | 17.00 EA. |

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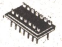
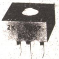


Ideal for use with flat ribbon cable or to mount components on.

14 pin **$0.56** 16 pin **$0.58** 24 pin **$0.94**

## CERMET SINGLE TURN TRIM POT



Spectrol model 63P
**ACTUAL SIZE**

STOCK VALUES
10, 20, 50, 100, 200, 500, 1K, 2K, 5K, 10K, 20K, 50K, 100K, 200K, 500K, 1M, 2M. 1—9 . . . . . . . . . . . . . . . . . . . **$0.85**
10+ Values may be mixed . . . . **$0.75**

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| | |
|---|---|
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|---|---|
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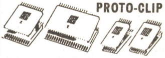
Spectrol model 534 ¼" shaft.
Price 1—9 . . . . . . . . . . . . . . . . . . **$6.75**
10 + values may be mixed **$5.75**

## CERMET 20 TURN TRIM POT

Spectrol Model 43P

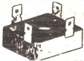
**ACTUAL SIZE**
STOCK VALUES
10, 20, 50, 100, 200, 500, 1K, 2K, 5K, 10K, 20K, 50K, 100K, 200K, 500K, 1M, 2M . . . . . . . . . . . . . . . . . . . . 1—9 **$1.10**
Values may be mixed. 10+ **$0.98**

## PROTO-CLIP



For power-on/hands off signal tracing. Bring IC leads up from PC board surface for last troubleshooting.
PC14 4.50 PC24 8.50
PC16 4.75 PC40 13.75

## BRIDGE RECTIFIERS



| | | | |
|---|---|---|---|
| W02 | 1.5 A | | |
| W04 | 1.5 A | | |
| KBPC 602 | 6 Amp | 200V | $1.50 |
| KBPC 606 | 6Amp | 600V | $1.75 |
| KBPC 1002 | 10 Amp | 200V | $1.95 |
| KBPC 1004 | 10 Amp | 400V | $2.25 |
| KBPC 3502 | 35Amp | 200V | $2.60 |
| KBPC 3504 | 35 Amp | 400V | $2.95 |

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|---|---|---|
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|---|---|
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## TI teaching system uses 16-bit CPU

Also provided on the TM900/189 board are a 16-bit parallel I/0 port, a bus interface for off-board memory expansion, and provision for off-board expansion of the parallel I/0 facilities to a total of 512 bits (32 x 8). There is also a socket for an optional 2K byte ROM or EPROM.

Along with the system hardware come two quite comprehensive manuals. One is a User Manual, the other an Introduction to Microprocessors training manual which uses the TM990/189 system as the basis for its treatment. Both books are unbound softcover editions, with the pages A4 size. One measures about 15mm thick while the other is about 42mm thick and has 500-odd pages.

Both books are packed full of information, and together they provide comprehensive training material. Their organisation is not as good as the best I have seen, however, and I get the impression that they have been put together rather hastily. This suggests that colleges may need to augment and/or guide students through the material, at least until they have gained a basic familiarity.

Despite this qualification I think the TM990/189 will be of considerable interest as a training system, if only because of its flexibility. It is also likely to be of interest as a low cost development system, by virtue of the fact that it is based on the TI 16-bit TMS9980A microprocessor.

Actually the TMS9980A is a particularly interesting micro, because it is virtually a 40-pin version of TI's powerful TMS9900 processor — which normally comes in a whopping 64-pin package.

How has TI managed to do without 24 of the pins, in order to get the processor into a 40-pin package? The answer is by pulling a number of tricks. One of these is to multiplex the 16-bit internal data bus onto an 8-bit bus for passing data to and from the chip; this also allows the use of byte-organised memory, as the data is all handled in bytes.

Another trick is to reduce the number of address lines to 14, so that the chip can only address 16,384 bytes of memory. This is quite reasonable, since the TMS9980A's powerful instruction set makes its programs very efficient.

A further trick is to have all I/0 communication with the processor carried out serially, via single input and output lines — one of which is actually multiplexed on the highest order address line. An internal 16-bit shift register called the "communications register unit" or CRU is used to send and receive data via these lines, and can send or receive either single bits of data or whole 16-bit words in response to single instructions.

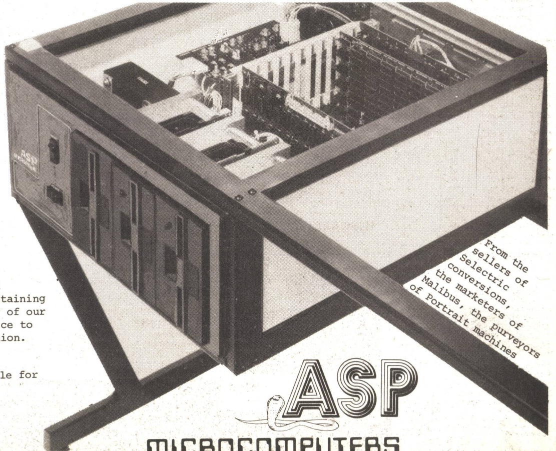
During data transfer via the CRU input and output lines, the processor uses the normal address bus to specify the intended source or destination. The addresses are specified for individual bits, and an 11-bit address is used for the CRU address space. A total of 2048 I/0 bit addresses are thus available.

Strobe signals are supplied by the processor during these transfers, so that the data can be fed to or derived from any desired interfacing circuitry.

An interesting feature of both the TMS9980A and the TMS9900 is that the CPU chips themselves have no on-chip accumulator registers. Instead they use a set of 16 accumulator/index registers which are implemented externally in the RAM. This "workspace" RAM area is specified by a workspace pointer (WP) register in the CPU, whose content can be changed along with the program counter.

This means that subroutines and interrupt routines can have their own set of working registers — a very powerful feature.

The TM9980/189 training system pictured was sent to us for review by Radio Despatch Service, of 869 George Street, Sydney NSW 2000, who advise that they will have good stocks by the time you read this. Their price for the system is $420, plus tax if applicable. EA



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## *Designed especially for beginners . . .*

# DREAM 6800

## *3rd article has interesting programs*

In this third article in the series on Michael Bauer's innovative design for the DREAM 6800 computer, we described how to connect it to a TV set and provide listings and instruction for sample programs. Next article in the series will give the lowdown on CHIP-8 programming.

Last month's article which gave complete construction details for the DREAM 6800, made only a brief mention of the video connection from the DREAM. The easiest way to connect the system to your TV set is to use an RF modulator (strictly speaking, this should be called a video-modulated RF oscillator), which enables a simple connection to the TV set antenna terminals.

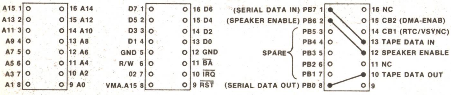
You may be able to wreck a defunct video game and use its modulator. While the modulators used in most video games do not provide very sharp resolution, they are quite suitable for the chunky graphics display of the DREAM. You can also purchase a suitable modulator complete with instructions, from Dick Smith Stores. Catalog price is $3.00.

Our approach was to make a direct video connection to the TV set. With the DREAM 6800, the method of video connection is less critical than for the usual "glass terminal" which uses the full screen and has small alpha-numeric characters. The fact that the DREAM uses a rectangle in the centre of the screen means that its relatively simple sync pulse "trains" will not cause "flag-waving" (horizontal jitter) at the top of the screen. The centrally located rectangular display also takes advantage of the superior linearity available in this area of the screen. So even old valve sets with quite poor linearity will give a reasonable display of the DREAM graphics.

The other reason why the DREAM is relatively non-critical of the method of video connection is that the chunky graphic display does not require as wide a picture bandwidth as a normal computer's alpha-numeric display. This means there is no need to improve the picture bandwidth by removing sound traps or other modifications.

Even so, the use of a direct video connection gives a quite worthwhile improvement in picture quality compared with that available via a RF modulator. And there is also less chance of interference to other TV sets in the near vicinity.

Our approach is to connect the video output from the DREAM to the input of the video amplifier in the TV set; ie, immediately after the video detector. If you have access to the circuit diagram of the set you should be able to find the appropriate spot in the circuit without any trouble. Ideally, the circuit will also show the shape and amplitude of the composite sync/video waveform which is normally present at the input to the video amplifier stage.



EXPANSION BUS (OPTION)

EXTENDED I/O SOCKET (OPTION)

*Held over from last month, this diagram shows the leadouts for the output sockets on the PCB.*

## STOP PRESS

*PCB suppliers such as RCS Radio Pty Ltd have indicated that their flux-coated PCB should not be scrubbed with steel wool and soap. The author's remarks apply only to non-flux-coated PCB's. For the many who have asked, the PCB pattern will be published in the August issue. We also hope to give a solution to the looming shortage of 6875 clock chips.*

For example, in a small valve portable TV set we modified for this purpose, the composite sync/video waveform is normally 2 volts peak-to-peak with positive video and negative sync. This is in the right ball-park for the DREAM, which has a composite sync/video amplitude of 1 volt peak-to-peak. All that we did was to connect the video from the DREAM via a 100uF/16VW electrolytic capacitor to the grid of the video amplifier valve.

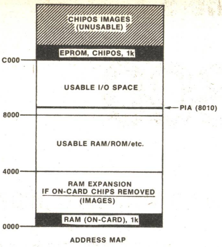
Much the same approach applies to solid state sets. Find the video detector and check the video waveform. Provided its polarity is correct and the amplitude is in the ball-park, you can feed the DREAM video signal into the base of the following video amplifier stage via a 100uF capacitor, as before.

The TV set tuner is set to an unused channel. This means that no video modulation is present from within the set. The DREAM video signal will swamp the noise to produce a sharp display.

By suitably adjusting the brightness and contrast controls, a bright and steady display is obtained. The polarity of the electrolytic coupling capacitor must be correct and it must have low leakage to avoid upsetting the bias of the following stage.

All the foregoing assumes that you have a set with earthed chassis and transformer isolation from the mains supply. If not, you will just have to use an RF modulator.

Some other sets which have a separate sync detector will not be suitable for the above method of video



| DEVICE | | BASE ADDRESS | ADDRESS LINES | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | A15 | A14 | A13 | A12 | A11 | A10 | A9 | A8 | A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0 |
| RAM (ON-CARD) | | 0000 | 0 | 0 | – | – | – | – | * | * | * | * | * | * | * | * | * | * |
| RAM (EXT)† | | 0000 | 0 | 0 | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| ANYTHING | | 4000 | 0 | 1 | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| PIA (ON-CARD) | | 8010 | 1 | 0 | | | | | | | | | | 1 | – | – | * | * |
| EXT. I/O DEVICES | 1 | 8020 | 1 | 0 | | | | | | | | | 1 | | * | * | * | * |
| | 2 | 8040 | 1 | 0 | | | | | | | | 1 | | | * | * | * | * |
| | 3 | 8080 | 1 | 0 | | | | | | | 1 | | | | * | * | * | * |
| | 4 | 8100 | 1 | 0 | | | | | | 1 | | | | | * | * | * | * |
| | 5 | 8200 | 1 | 0 | | | | | 1 | | | | | | * | * | * | * |
| | 6 | 8400 | 1 | 0 | | | | 1 | | | | | | | * | * | * | * |
| CHIPOS EPROM | | C000 | 1 | 1 | – | – | – | – | * | * | * | * | * | * | * | * | * | * |

DEVICE-SELECT TABLE

KEY

| | |
|---|---|
| 0 | LINE MUST BE LOW TO SELECT DEVICE |
| 1 | LINE MUST BE HIGH TO SELECT DEVICE |
| * | LINE IS DECODED BY DEVICE TO SELECT REQUIRED BYTE; NOTE: I/O DEVICES MAY HAVE UP TO 16 ADDRESSABLE 1-BYTE REGISTERS |
| – | IRRELEVANT (DONT CARE) |
| (BLANK) | LINE IS NOT DECODED, BUT MUST BE LOW TO AVOID BUS CONTENTION |
| † | IF EXTERNAL RAM IS PUT AT 0000, THEN ON CARD RAM MUST BE REMOVED OR RELOCATED (E.G. TO 4000); |

*Memory map for the Dream 6800.*

connection. In these cases it may be possible to connect the sync and video from the DREAM separately, rather than use the composite waveform.

It is possible that the polarity of the video waveform within your set is reversed to that from the DREAM. This will result in poor or incorrect picture sync and a negative (ie, reversed) picture. The solution in this case is to build a single-stage common-emitter amplifier which will provide the necessary waveform polarity reversal.

Finally, if you propose to use an old set for which no circuit diagram is available, it is usually possible to identify the video amplifier relatively quickly. Just take note of the single wire from the picture tube socket which is the video output. Trace this back to the appropriate valve. From there it should be easy to identify the grid. This can be done by measuring voltages — the grid will usually be a few volts negative with respect to chassis.

The same approach would apply to solid state black and white TV sets. The video output transistor can be found by tracing the video output lead to the picture tube, back to its source. From there it's a matter of identifying the base of the transistor and then feeding the signal in via a 100uF capacitor, as before.

Well now you should be champing at the bit to get some programs entered and running. Enter each program in the following sequence and, as soon as you have it running, dump it on cassette. There is nothing so boring as having to enter the same hex listing twice! So make sure you dump all your programs onto tape. Note: Of the following programs, "Block Puzzle" and "TV Typewriter" were written by M. J. Bauer while the others were adapted from the "RCA Cosmac VIP" Instruction Manual.

*Repeated from the first article in May 1979, this photograph shows the TV displaying the random number generator after the program has been stopped. The "3333" address does not normally occur but was typed in to give good digit display (when this photograph was taken, our prototype was blurring some digits becase of a low spec 4014B IC.)*

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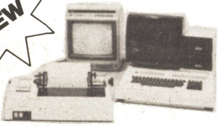

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**OPTIONS**
See M180 & M190 models.

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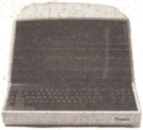

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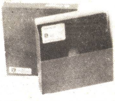

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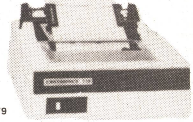

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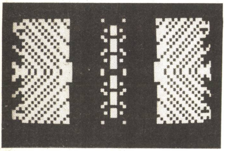
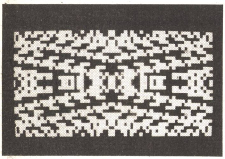
# DREAM 6800 — SAMPLE PROGRAMS TO GET YOU STARTED

## KALEIDOSCOPE

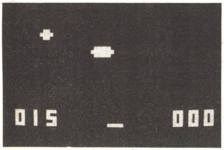
Use keys 2,4,6 and 8 to enter a short sequence of movements. then press key 0 and watch the computer repeat the sequence to create a moving, symmetrical pattern. Try 44444442220, then experiment with other nice patterns.



*Just two of the many Kaleidoscope patterns.*



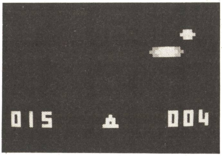
```
0200   6000 6380 611F 620F
0208   2232 A200 F31E F00A
0210   F055 4000 121C 7301
0218   3300 1208 6380 A200
0220   F31E F065 4000 121C
0228   7301 4300 121C 2232
0230   121E 4002 72FF 4004
0238   71FF 4006 7101 4008
0240   7201 A277 6AE0 8A12
0248   6B1F 81B2 3A00 7201
0250   6AF0 8A22 6B0F 82B2
0258   3A00 7101 6B1F 81B2
0260   D121 8A10 6B1F 8B25
0268   DAB1 6A3F 8A15 DAB1
0270   8B20 DAB1 00EE 0180
0278   0000
```



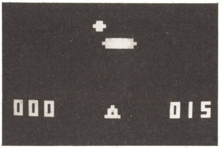
*Start of the UFO Intercept game.*

## UFO INTERCEPT

Launch a missile with key 4, 5 or 6 (left, up, right). Hit the small UFO to score 15, the big one to score 5. You have 15 shots.



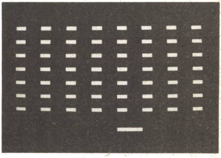
*Two more views of the UFO Intercept game.*



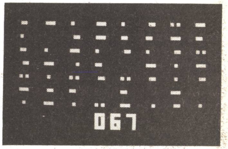
```
0200   A2CD 6938 6A08 D9A3
0208   A2D0 6B00 6C03 DBC3
0210   A2D6 641D 651F D451
0218   6700 680F 22A2 22AC
0220   4800 1222 641E 651C
0228   A2D3 D453 6E00 6680
0230   6D04 EDA1 66FF 6D05
0238   EDA1 6600 6D06 EDA1
0240   6601 3680 22D8 A2D0
0248   DBC3 CD01 8BD4 DBC3
0250   3F00 1292 A2CD D9A3
0258   CD01 3D00 6DFF 79FE
0260   D9A3 3F00 128C 4E00
0268   122E A2D3 D453 4500
0270   1286 75FF 8464 D453
0278   3F01 1246 6D08 8D52
0280   4D08 128C 1292 22AC
0288   78FF 121E 22A2 7705
0290   1296 22A2 770F 22A2
0298   6D03 FD18 A2D3 D453
02A0   1286 A2F8 F733 6300
02A8   22B6 00EE A2F8 F833
02B0   6332 22B6 00EE 6D1B
02B8   F265 F029 D3D5 7305
02C0   F129 D3D5 7305 F229
02C8   D3D5 00EE 017C FE7C
02D0   60F0 6040 E0A0 F8D4
02D8   6E01 6D10 FD18 00EE
```

## WIPE OFF

Use keys 4 and 6 to serve ball and move bat. Score is shown at end of game, after 20 balls. For smaller bat, change data at 1oc. 02CD to FO. For a bat with a hole, use E7!



*Start and finish of the game of Wipe-Off.*



```
0200   A2CC 6A07 6100 6B08
0208   6000 D011 7008 7BFF
0210   3B00 120A 7104 7AFF
0218   3A00 1206 6600 6714
0220   A2CD 6020 611E D011
0228   631D 623F 8202 77FF
0230   4700 12AA FF0A A2CB
0238   D231 65FF C401 3401
0240   64FF A2CD 6C00 6E04
0248   EEA1 6CFF 6E06 EEA1
0250   6C01 D011 80C4 D011
0258   4F01 1298 4200 6401
0260   423F 64FF 4300 6501
0268   431F 12A4 A2CB D231
0270   8244 8354 D231 3F01
0278   1242 431E 1298 6A02
0280   FA18 7601 4670 12AA
0288   D231 C401 3401 64FF
0290   C501 3501 65FF 1242
0298   6A03 FA18 A2CB D231
02A0   73FF 1236 A2CB D231
02A8   1228 A2CD D011 A2F0
02B0   F633 F265 6318 641B
02B8   F029 D345 7305 F129
02C0   D345 7305 F229 D345
02C8   12C8 0180 44FF
```

(Continued on page 89)

# Discount Components

## SPECIALS

| | | | | | |
|---|---|---|---|---|---|
| 10 RED LEDS | $1.50 | 100 RED LEDS | $13.00 | 10 uA301 | $3.30 |
| 7805 | 90c | 10 4016 | $4.50 | 4N28 | $1.00 |
| 7812 | 90c | 6 LUG TAG STRIPS | 5c | 4N29 | $1.10 |
| LM317K | $2.90 | 309K | $1.50 | 10 7490 | $3.00 |
| TIL209 | 18c | 10 GREEN LEDS | $2.90 | 10 74123 | $5.00 |
| 10 BC547 | $1.20 | 10 YELLOW LEDS | $2.90 | 10 741 | $2.90 |
| IN4003 | 7c | 10 4011 | $2.00 | LED CLIPS | 2c |
| IN4002 | 7c | 10 74LS00 | $2.00 | 10 723 | $4.50 |

### LINEARS

| | |
|---|---|
| 301 | .40 |
| 307 | .65 |
| 308 | 1.25 |
| 309K | 1.90 |
| 311 | .80 |
| 317K | 2.90 |
| 318 | 3.25 |
| 324 | 1.25 |
| 325 | 4.60 |
| 339 | .85 |
| 348 | 1.60 |
| 349 | 2.25 |
| 356 | 1.65 |
| 377 | 2.75 |
| 379S | 6.95 |
| 380 14 Pin | 1.30 |
| 381 | 1.95 |
| 382 | 1.95 |
| 387 | 1.90 |
| 386 | 1.90 |
| 555 | .35 |
| 556 | .85 |
| 565 | 1.90 |
| 566 | 2.40 |
| 567 | 2.60 |
| 709 | .70 |
| 723 (VR) | .50 |
| 741 | .30 |
| 747 | .90 |
| 3900 | .85 |
| 3909 | 1.20 |
| CA3028 | 2.90 |
| CA3046 | 2.10 |
| CA3130 | 1.95 |
| CA3140 | 1.95 |
| RL4136 | 2.90 |

### REGULATORS

| | |
|---|---|
| 7805 | 1.00 |
| 7806 | 1.20 |
| 7808 | 1.20 |
| 7812 | 1.00 |
| 7815 | 1.20 |
| 7818 | 1.20 |
| 7824 | 1.20 |
| 7905 | 1.50 |
| 7906 | 1.50 |
| 7908 | 1.50 |
| 7924 | 1.50 |
| 7912 | 1.50 |
| 7915 | 1.50 |
| 78L05 | .40 |
| 78L12 | .40 |
| 78HGKC | 8.50 |
| 78H05 | 7.90 |
| 78H12 | 7.90 |
| 723 | .50 |
| 309K | 1.90 |
| 317K | 2.90 |

### OPTO

| | |
|---|---|
| FND357 C.C. | 1.30 |
| FND500 C.C. | 1.25 |
| FND507 C.A. | 1.40 |
| FND800 C.C. | 3.50 |
| TIL209 Leds | .20 |
| RED LEDS | .18 |
| 100 for | 13.00 |
| YELLOW | .30 |
| GREEN | .30 |
| Mounting Clips | .3 |

### DIODES

| | |
|---|---|
| 1N4148 | .5 |
| 100 for | 4.00 |
| 1N4002 | .7 |
| 1N4003 | .8 |
| 1N4004 | .9 |
| 100 for | 7.00 |
| 1N5625 | .50 |

### RESISTORS

| | |
|---|---|
| 1/2 Watt I.R.H. Metal Glaze 1 ohm to 1M (E24 Values), 1-99 | .3 |
| 100-999 | .2.5 |

### TRANSISTORS

| | |
|---|---|
| BC547/8/9 | .15 |
| BC557/8/9 | .20 |
| BD139 | .55 |
| BD140 | .55 |
| 2N3055 | .85 |
| MJ2955 | .95 |
| BC337 | .25 |
| BC338 | .25 |
| BF115 | .85 |
| BF180 | .75 |
| PN3643 | .25 |
| PN3645 | .25 |

### BRIDGES

| | |
|---|---|
| MDA3501 35A 100V | 4.10 |
| MDA3502 35A 200V | 4.20 |
| MDA3504 35A 400V | 4.50 |
| WO4 1.5A 400V | .80 |

### SCR

| | |
|---|---|
| C103YY .8A 60V | .80 |
| C106A1 4A 100V | .95 |
| C106D1 4A 400V | 1.30 |
| C122D1 8A 400V | 2.50 |
| C122E 8A 500V | 2.60 |

### I.C. SOCKETS

| | |
|---|---|
| 8 PIN | .25 |
| 14 PIN | .33 |
| 16 PIN | .35 |
| 18 PIN | .50 |
| 20 PIN | .60 |
| 22 PIN | .75 |
| 24 PIN | .80 |
| 28 PIN | .90 |
| 40 PIN | 1.00 |

### TTL

| | |
|---|---|
| 7400 | .25 |
| 7401 | .25 |
| 7402 | .25 |
| 7403 | .25 |
| 7404 | .35 |
| 7405 | .35 |
| 7406 | .50 |
| 7407 | .50 |
| 7408 | .32 |
| 7409 | .32 |
| 7410 | .25 |
| 7411 | .35 |
| 7413 | .55 |
| 7414 | .90 |
| 7416 | .60 |
| 7417 | .60 |
| 7420 | .25 |
| 7421 | .50 |
| 7422 | .30 |
| 7426 | .45 |
| 7417 | .45 |
| 7430 | .30 |
| 7432 | .40 |
| 7437 | .50 |
| 7438 | .50 |
| 7440 | .30 |
| 7441 | 1.50 |
| 7442 | .70 |
| 7447 | .95 |
| 7448 | .95 |
| 7450 | .35 |
| 7451 | .35 |
| 7453 | .35 |
| 7454 | .30 |
| 7460 | .35 |
| 7470 | .65 |
| 7472 | .45 |
| 7473 | .60 |
| 7474 | .65 |
| 7475 | .65 |
| 7476 | .45 |
| 7480 | 1.25 |
| 7483 | 1.25 |
| 7485 | 1.45 |
| 7486 | .65 |
| 7489 | 1.90 |
| 7490 | .50 |
| 7491 | 1.00 |
| 7492 | .65 |
| 7493 | .65 |
| 7494 | 1.10 |
| 7495 | .95 |
| 74100 | 2.45 |
| 74107 | .65 |
| 74121 | .50 |
| 74123 | .90 |
| 74132 | 1.25 |
| 74150 | 1.60 |
| 74151 | 1.10 |
| 74153 | 1.10 |
| 74154 | 1.70 |
| 74157 | 1.10 |
| 74160 | 1.55 |
| 74161 | 1.75 |
| 74164 | 1.55 |
| 74165 | 1.55 |
| 74173 | 2.75 |
| 74175 | 1.65 |
| 74180 | 1.35 |
| 74192 | 1.40 |
| 74193 | 1.40 |
| 74197 | 1.50 |
| 74221 | 1.50 |
| 74251 | 1.50 |
| 74367 | 1.20 |
| 74368 | 1.20 |

### 74LS

| | |
|---|---|
| 74LS00 | .25 |
| 74LS01 | .30 |
| 74LS02 | .25 |
| 74LS03 | .30 |
| 74LS04 | .35 |
| 74LS05 | .35 |
| 74LS08 | .30 |
| 74LS09 | .30 |
| 74LS10 | .25 |
| 74LS11 | .30 |
| 74LS12 | .30 |
| 74LS14 | 1.00 |
| 74LS15 | .35 |
| 74LS20 | .30 |
| 74LS21 | .30 |
| 74LS22 | .35 |
| 74LS26 | .40 |
| 74LS27 | .30 |
| 74LS28 | .40 |
| 74LS30 | .30 |
| 74LS32 | .30 |
| 74LS37 | .45 |
| 74LS38 | .45 |
| 74LS40 | .30 |
| 74LS42 | 1.10 |
| 74LS47 | 1.40 |
| 74LS48 | 1.50 |
| 74LS49 | 1.80 |
| 74LS51 | .45 |
| 74LS54 | .45 |
| 74LS55 | .45 |
| 74LS73 | .90 |
| 74LS74 | .50 |
| 74LS75 | .70 |
| 74LS76 | .95 |
| 74LS78 | .50 |
| 74LS83 | 1.50 |
| 74LS85 | 1.50 |
| 74LS86 | .50 |
| 74LS90 | 1.10 |
| 74LS92 | 1.20 |
| 74LS93 | 1.10 |
| 74LS95 | 1.50 |
| 74LS107 | 1.20 |
| 74LS109 | .50 |
| 74LS112 | 1.20 |
| 74LS113 | .55 |
| 74LS114 | .55 |
| 74LS122 | 2.00 |
| 74LS123 | 1.90 |
| 74LS125 | 1.90 |
| 74LS126 | 1.50 |
| 74LS132 | 1.60 |
| 74LS126 | .79 |
| 74LS138 | 1.20 |
| 74LS139 | 1.90 |
| 74LS151 | 1.20 |
| 74LS153 | 1.90 |
| 74LS154 | 1.60 |
| 74LS157 | 1.00 |
| 74LS158 | 1.90 |
| 73LS160 | 2.20 |
| 74LS161 | 2.20 |
| 74LS162 | 2.30 |
| 74LS163 | 1.20 |
| 74LS164 | 1.30 |
| 74LS168 | 3.30 |
| 74LS169 | 3.50 |
| 74LS170 | 3.50 |
| 74LS173 | 2.10 |
| 74LS174 | 1.00 |
| 74LS175 | 1.00 |
| 74LS190 | 2.80 |
| 74LS191 | 1.20 |
| 74LS192 | 1.20 |
| 74LS193 | 1.20 |
| 74LS194 | 1.20 |
| 74LS195 | 1.20 |
| 74LS196 | 1.20 |
| 74LS197 | 1.90 |
| 74LS221 | 1.90 |
| 74LS253 | 1.85 |
| 74LS279 | .65 |
| 74LS365 | .75 |
| 74LS366 | .90 |
| 74LS367 | .75 |
| 74LS368 | .75 |
| 74LS386 | .95 |

### CMOS

| | |
|---|---|
| 4000 | .40 |
| 4001 | .25 |
| 4002 | .25 |
| 4006 | 1.40 |
| 4007 | .25 |
| 4008 | 1.25 |
| 4010 | 1.25 |
| 4011 | .25 |
| 4012 | .25 |
| 4013 | .55 |
| 4014 | 1.30 |
| 4015 | 1.20 |
| 4016 | .50 |
| 4017 | 1.30 |
| 4018 | 1.40 |
| 4019 | .75 |
| 4020 | 1.55 |
| 4021 | 1.35 |
| 4022 | 1.60 |
| 4023 | .25 |
| 4024 | .90 |
| 4025 | .40 |
| 4026 | 2.10 |
| 4027 | .80 |
| 4028 | 1.25 |
| 4029 | 1.85 |
| 4030 | .40 |
| 4040 | 1.30 |
| 4041 | 1.25 |
| 4042 | 1.25 |
| 4043 | 1.59 |
| 4044 | 1.50 |
| 4046 | 1.80 |
| 4049 | .60 |
| 4050 | .60 |
| 4051 | 1.20 |
| 4052 | 1.20 |
| 4053 | 1.20 |
| 4060 | 2.60 |
| 4066 | 1.00 |
| 4068 | .40 |
| 4069 | .35 |
| 4070 | .40 |
| 4071 | .40 |
| 4072 | .40 |
| 4073 | .40 |
| 4074 | .40 |
| 4076 | 1.85 |
| 4077 | .40 |
| 4078 | .40 |
| 4081 | .40 |
| 4082 | .40 |
| 4510 | 1.40 |
| 4511 | 1.40 |
| 4518 | 1.50 |
| 4519 | .95 |
| 4520 | 1.45 |
| 4528 | 1.20 |
| 14553 | 7.30 |
| 14584 | 1.25 |
| 74C00 | .40 |
| 74C02 | .40 |
| 74C04 | .40 |
| 74C08 | .40 |
| 74C10 | .40 |
| 74C14 | 1.75 |
| 74C48 | 2.40 |
| 74C73 | 1.20 |
| 74C75 | 1.20 |
| 74C76 | 1.35 |
| 74C90 | 2.20 |
| 74C93 | 2.20 |
| 74C175 | 1.85 |
| 74C192 | 2.20 |
| 74C193 | 2.20 |
| 74C221 | 2.20 |

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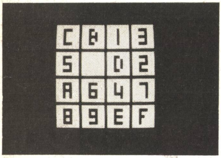
# ROD IRVING ELECTRONICS

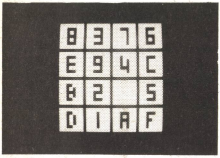
# DREAM 6800 — HAS BUILT-IN CASSETTE INTERFACE FOR EASY PROGRAM STORAGE

## BLOCK PUZZLE

The screen shows a 4 x 4 board with symbols 0 to 9, A to F arranged in order, with a blank square upper left. Watch the computer jumble the blocks, then you try to re-order them using keys 2 (down), 4 (left), 6 (right) and 8 (up) to move a block into the blank space.



*Each start for the Block Puzzle is different.*



```
0200  6A12 6B01 6110 6200
0208  6000 A2B0 D127 F029
0210  3000 DAB5 7108 7A08
0218  3130 1224 6110 7208
0220  6A12 7B08 A300 F01E
0228  F055 7001 3010 120A
0230  6A12 6B01 6C00 62FF
0238  C006 7002 2252 72FF
0240  3200 1238 6E00 0000
0248  F00A 2252 7E01 0000
0250  1248 84A0 85B0 86C0
0258  3002 1264 4501 1264
0260  75F8 76FC 3008 1270
0268  4519 1270 7508 7604
0270  3006 127C 4412 127C
0278  74F8 76FF 3004 1288
0280  442A 1288 7408 7601
0288  A300 F61E F065 8100
0290  6000 A300 F61E F055
0298  A300 FC1E 8010 F055
02A0  F129 D455 DAB5 8A40
02A8  8B50 8C60 00EE EE5E
02B0  FEFE FEFE FEFE FEFE
```

---

## ERRATA

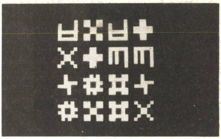
*The DREAM 6800 uses a 6821 PIA instead of the 6820 shown on circuit and PCB diagram.*

## CONCENTRATION

Two players, A and B, take turns to find matching pairs of symbols arranged in a 4 x 4 matrix. The hex keys correspond to board positions, so just press a key to see the symbol there. When player A gets a match, the computer replaces his two symbols with A's, and same for B, so you can see who won. The computer also shows whose turn it is to play.

```
0200  A385 6002 6102 6202
0208  6302 6402 6502 6602
0210  6702 F755 6300 A385
0218  C107 F11E F065 4000
0220  1216 70FF A385 F11E
0228  F055 A38E F31E 8010
0230  F055 7301 3310 1216
0238  2314 C501 22C4 6B00
0240  6D10 F00A A375 F01E
0248  F065 90D0 1242 8D00
0250  22D8 3B00 125E 6B0F
0258  8CD0 89A0 1242 6020
0260  F015 F007 3000 1262
0268  99A0 1278 22C4 7501
0270  6001 8502 22A0 123C
0278  6020 F018 7E01 22A0
0280  A385 FA1E 60DD F055
0288  4500 1296 A367 D346
0290  A367 D126 12B8 A33F
0298  D346 A33F D126 12B8
02A0  22D8 8130 8240 8DC0
02A8  22D8 00EE A36D FA1E
02B0  F065 A334 F01E 00EE
02B8  0000 123E 22C4 6060
02C0  F018 12C2 6300 6408
02C8  A33F 4500 12D2 633A
02D0  A367 D346 00EE 5555
02D8  A38E FD1E F065 8A00
02E0  A385 F01E F065 40DD
02E8  1242 22AC 6310 6400
02F0  600C 80D2 4004 6408
02F8  4008 6410 400C 6418

0300  6003 80D2 4001 6318
0308  4002 6320 4003 6328
0310  D346 00EE 2324 6040
0318  F015 F007 3000 131A
0320  2324 00EE 6D00 22D8
0328  7D01 4D10 1330 1326
0330  00EE 0101 1010 1E78
0338  0808 1818 7E7E 1818
0340  2424 3C24 2466 6618
0348  1866 667E 2424 7E66
0350  4224 1818 2442 7E52
0358  5252 527E 4242 7E42
0360  7E14 7C26 643E 287C
0368  243C 2424 7C00 0611
0370  161C 2227 2D0C 0D0E
0378  0F08 090A 0B04 0506
0380  0700 0102 0300
```



*This is the start of the Concentration game.*

## SECRET NUMBER

The computer is thinking of a secret (random), 3-digit, decimal number. You try to guess what it is, with the help of "clues" from the computer. Simply enter your 3-digit guess, shown upper left. The computer's clue, shown bottom left (momentarily), is a number calculated as follows: starts with 0; adds 2 for each correctly guessed digit in the correct position; then adds 1 for each guess digit which is present in the secret number but in the wrong place. The number of tries you took is shown bottom right.

```
0200  6E00 A3F0 22A0 22A0
0208  22A0 6500 6000 6100
0210  6200 F255 22AE 6534
0218  22D0 A3F6 22E2 22E2
0220  22E2 6500 22AE A3F6
0228  F265 A3F3 F255 6500
0230  22AE 6402 6D00 A3F3
0238  22F4 A3F3 F255 8500
0240  A3F0 22F4 A3F0 F255
0248  9500 1300 9510 1252
0250  9520 7D01 4400 125C
0258  74FF 1236 6508 22D0
0260  6534 22D0 7E01 6534
0268  22D0 4D06 1288 4E63
0270  1282 6130 F115 F107
0278  3100 1276 6508 22D0
0280  121A A3F0 652C 22AE
0288  6108 6002 F018 6F10
0290  71FF FF15 FF07 3F00
0298  1294 3100 128A 0C00
02A0  6409 C00F 8405 4F00
02A8  12A0 F055 00EE 6600
02B0  3500 12C6 A3F3 F265
02B8  F029 22CA F129 22CA
02C0  F229 22CA 00EE A3F0
02C8  12B6 D565 7508 00EE
02D0  6618 3508 12DA FD29
02D8  12CA A3F6 FE33 F265
02E0  12BC F00A 400F 1282
02E8  6109 8105 4F00 12E2
02F0  F055 00EE F265 8300
02F8  8010 8120 8230 00EE
0300  7D02 1254
```

(Continued on page 90)

### T.V. TYPEWRITER

Starts with cleared screen and a cursor in the upper LHS corner. Enter a 2-digit number (character code) from 00 to 2F (total of 48 codes), noting the characters produced by each. The cursor can be moved by entering a 2-digit control code. The first digit specifies the direction: C (left), D (down), E (up), F (right). The second digit specifies how many dot positions to move. A mistake can be erased by positioning the cursor on top of the offending character and re-keying its code.

```
0200  6A00 6B00 602F 0266
0208  DAB5 F00A 0277 8100
0210  F00A 8101 602F 0266
0218  DAB5 8010 62C0 8122
0220  41C0 1234 4016 1250
0228  4020 1254 0266 DAB5
0230  7A04 1204 8200 64F0
0238  8242 640F 8042 42C0
0240  8A05 42D0 8B04 42E0
0248  8B05 42F0 8A04 1204
0250  A25C 1256 A25D DAB5
0258  7A06 1204 F8A8 A8A8
0260  A850 0000 0000 9630
0268  810F 2203 7EC1 9380
0270  10CE 027E 7EC1 9896
0278  3048 4848 4897 3039
0280  F6CE B7DA E92E F492
0288  B75A F248 B7FA B6DE
0290  F6DE 93DE 5EDE BBDE
0298  C546 492E F6DA 56DA
02A0  BFDA B55A 4BDA F11E
02A8  0024 2A22 88A8 8000
02B0  0BA0 0380 1550 1110
02B8  0820 1C70 419E FFFE
```

### TANK BATTLE

Use keys 4 (left), 9 (up), 6 (right) and 1 (down) to move your tank about. Fire a shot with key F. Hit the randomly moving hostile enemy vehicle and you score 10 points. If you allow the target to collide with your tank, 5 shots will be forfeited. After each round, the score (left) and remaining number of shots are shown.

```
0080  76FB 6020 8065 4F00
0088  6600 1354

0200  6E00 6DA0 6A01 6906
0208  6804 6709 6619 6410
0210  630C 6200 6106 A092
0218  FA55 23A4 6040 F015
0220  F007 3000 1220 23A4
0228  22DA 2332 A092 F565
0230  227E 2296 22BC 3F01
0238  22E4 3F01 22BC 3F01
0240  22BC 3F01 224C 4F01
0248  1336 1232 A092 F565
0250  4600 3500 1258 135C
0258  E7A1 6209 E8A1 6204
0260  E9A1 6206 EAA1 6201
0268  4200 00EE 227E 8120
0270  236A 237C 6C01 6200
0278  6F00 A092 F555 A3CF
0280  4109 6000 4104 6013
0288  4106 600D 4101 6006
0290  F01E D347 00EE 600F
0298  E09E 00EE 450F 00EE
02A0  650F 76FF A092 F555
02A8  7403 7303 236A 236A
02B0  236A A0A3 F555 A3E9
02B8  D341 00EE A0A3 F565
02C0  4500 00EE A3E9 D341
02C8  236A 6C02 238E 4BBB
02D0  12DA D341 A0A3 F555
02D8  00EE 6500 6000 A097
02E0  F055 12D4 A09D F565
02E8  350F 1314 A3EA D345
02F0  3200 1302 C103 A099
02F8  F11E F065 8100 C20F

0300  7201 236A A3EA 6C03
0308  72FF 6F00 D345 A09D
0310  F555 00EE C407 A3EF
0318  F41E F065 8300 A3F7
0320  F41E F065 8400 A3EA
0328  D345 6020 F018 650F
0330  130E 6500 130E 4C01
0338  1080 4C02 1352 A0A3
0340  F565 4500 1080 A3E9
0348  D341 6F00 D341 3F01
0350  1080 7E0A 6040 F018
0358  00E0 121A 00E0 23A4
0360  6060 F018 1364 6E00
0368  1354 4109 74FF 4104
0370  73FF 4106 7301 4101
0378  7401 00EE 4400 7401
0380  4300 7301 4338 73FF
0388  4418 74FF 00EE 6B00
0390  4400 139E 4300 139E
0398  433F 139E 441F 6BBB
03A0  6F00 00EE 6308 6408
03A8  A0A9 FE33 F265 23BC
03B0  6328 A0A9 F633 F265
03B8  23C2 00EE F029 D345
03C0  7306 F129 D345 7306
03C8  F229 D345 00EE 0110
03D0  547C 6C7C 7C44 7C7C
03D8  6C7C 5410 00FC 786E
03E0  78FC 003F 1E76 1E3F
03E8  0080 A870 F870 A80B
03F0  1B28 3830 2010 0000
03F8  0000 081B 181B 13D4
```

(Continued next month)

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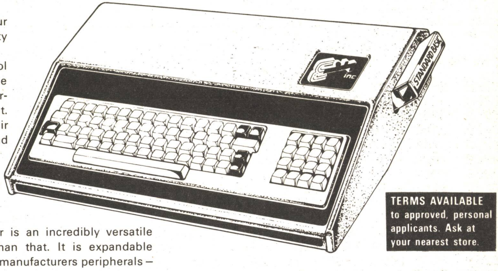

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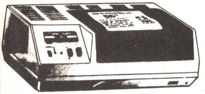

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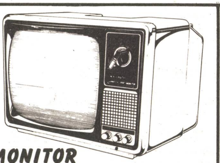

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# Software driven keyboard for D2 kits

If you have a Motorola MEK6800D2 evaluation kit and long to be able to use a full size alphanumeric keyboard for program, data or text entry, here is a simple, cheap and flexible method. The only requirements are an unencoded keyboard and some software.

**by DAVID L. CRAIG**
134 Victor Street, Holland Park, Qld 4121

Like many of the other small microprocessor evaluation kits, the Motorola 6800 D2 kit uses a small hexadecimal keyboard for program entry and debugging. This style of keyboard is very satisfactory as a low cost input device for machine language programs. However, when it comes to running an assembler, a text editor, BASIC, or programs requiring interactive human input, the hexadecimal keyboard isn't really suitable. There simply aren't enough keys. A full size alphanumeric ASCII keyboard is needed.

The usual approach to interface an ASCII keyboard to a microprocessor is to use a specialized keyboard encoder IC such as the MM5740, to generate the ASCII equivalent of the keyclosure. The ASCII code is then serialized using a UART and fed to the microprocessor using a 20mA current loop. At the processor end an ACIA and a software routine are used to input the data from the keyboard. Problems with this method include cost, availability of specialized ICs, and compatibility of the keyboard with the encoder IC.

If you have one of the popular Motorola D2 kits and want to add a full size alphanumeric keyboard, there is a simpler and cheaper method which uses software scanning. The only hardware needed is an unencoded keyboard with a single-pole, normally open switch for each key and the "user PIA" built into the D2 kit. This not only provides a cheaper method of adding a keyboard, but also a more flexible one. Any keycode, not just the ASCII which is used in this article, can be generated, and the function of any key on the keyboard can be changed simply by changing an entry in a software lookup table.

The keyboard used by the author was one from Dick Smith Electronics. This is a readily available keyboard which has been used before, in the EA Video Terminals published in February 1977 and April 1978. It has 63 keys with gold-plated, single pole switches, and almost all the keytop designations fit in with the standard ASCII code.

Almost any other keyboard could be used alternatively, if desired. Some changes to the ASCII lookup table in the software may be necessary to make ASCII code generated for a particular key line up with the keytop designation.

The keyswitches have to be wired in an 8 x 8 matrix configuration. One side of each keyswitch is wired to a row of the matrix, and the other to a column. Though any arrangement of keys in the matrix can be used, the suggested matrix layout shown in Fig. 1 makes wiring relatively simple for the DSE keyboard. Of the special keys, only the SHIFT keys (2 non-locking and 1 locking) are given their normal function. The other special keys, eg CTRL, REPEAT, BREAK are wired as ordinary keys in the matrix. Any ASCII character can be assigned to these keys in the software.

The user PIA at memory location X'8004 in the D2 kit is used under software control to scan the keyboard matrix, detect a key closure, and to identify the key closed. The 8 x 8 keyboard matrix is wired to the PIA by taking rows rows 0-7 to PB0-7, and columns 0-7 to PA0-7 respectively. In addition, the SHIFT keys are wired into row 7 of the matrix and taken to CA2 of the PIA. This is to allow identification of the SHIFT key and an ordinary key when pushed simultaneously, to provide the normal shift function. In all, 17 wires are required between the keyboard and the PIA.

The rows of the keyboard are driven by the PB0-7 lines of the PIA, which are configured as outputs. The state of the columns is monitored by reading the PA0-7 lines of the PIA, which are configured as inputs. With no key closed the PA0-7 inputs float high, because of internal pull-up resistors in

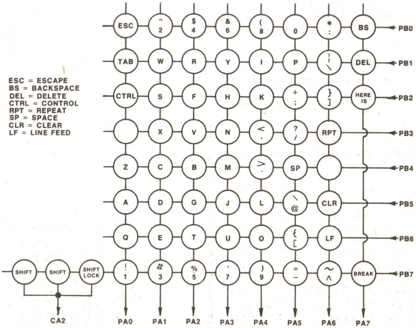

FIG. 1 : KEYBOARD MATRIX WIRING

*In the schematic at right, the column and row lines connect to the D2 kit's PIA lines.*

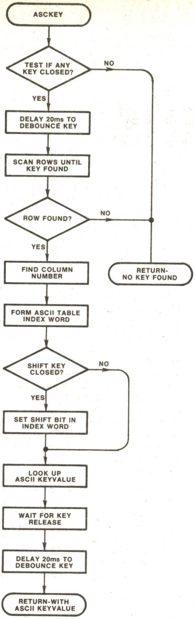
ASCKEY
TEST IF ANY KEY CLOSED?
NO
YES
DELAY 20ms TO DEBOUNCE KEY
SCAN ROWS UNTIL KEY FOUND
ROW FOUND?
NO
YES
FIND COLUMN NUMBER
RETURN-NO KEY FOUND
FORM ASCII TABLE INDEX WORD
SHIFT KEY CLOSED?
NO
YES
SET SHIFT BIT IN INDEX WORD
LOOK UP ASCII KEYVALUE
WAIT FOR KEY RELEASE
DELAY 20ms TO DEBOUNCE KEY
RETURN-WITH ASCII KEYVALUE

FIG. 2: "ASCKEY" SUBROUTINE FLOWCHART

| BIT 7 | BIT 6 | BIT 5 | BIT 4 | BIT 3 | BIT 2 | BIT 1 | BIT 0 |
|---|---|---|---|---|---|---|---|
| 0 | SHIFT | ROW NUMBER | | | COLUMN NUMBER | | |

FIG. 3 : ASCII TABLE INDEX WORD FORMAT

*Here is the flow chart, index word format and source listing for the ASKEY subroutine.*

```
'ASCKEY' SUBROUTINE LISTING

        E0 DD       DLY20   EQU   $E0DD       DELAY S/R IN JBUG
        80 04       COLREG  EQU   $8004       PIA A DATA REGISTER
        80 05       COLCTR  EQU   COLREG + 1  PIA A CONTROL REGISTER
        80 06       ROWREG  EQU   COLREG + 2  PIA B DATA REGISTER
        80 07       ROWCTR  EQU   COLREG + 3  PIA B CONTROL REGISTER
        00 70       ASCTAB  EQU   0070        ASCII LOOKUP TABLE START ADDRESS

                ** INITIALIZE REGISTERS **

0000    CE 80 04    ASCKEY  LDX#COLREG
0003    86 04               LDAA#$04
0005    C6 FF               LDAB#$FF

     **INITIALIZE PIA A SIDE-PA0-7 AS INPUTS, IRQA2 SET ON CA2 LOW,

                            INTERRUPTS DISABLED **
0007    6F 01               CLR1,X
0009    6F 00               CLR0,X
000B    A7 01               STAA1,X

     ** INITIALIZE PIA B SIDE  -  PB0-7 AS OUTPUTS **

000D    6F 03               CLR3,X
000F    E7 02               STAB2,X
0011    A7 03               STAA3,X

     ** TEST IF ANY KEY CLOSED BY DRIVING ALL ROWS LOW TOGETHER**

0013    00 00               NOP
0015    6F 02               CLR2,X         OUTPUT ALL ROWS LOW
0017    E1 00               CMPB0,X        TEST IF ANY KEY CLOSED
0019    27 16               BEQ NOKEY

     ** DELAY 20 MSEC TO DEBOUNCE KEY **

001B    BD E0 DD            JSR DLY20

     ** FIND WHICH KEY CLOSED BY DRIVING ROWS LOW ONE AT A TIME **
001E    CE 80 04            LDX#COLREG
0021    86 7F               LDAA#$7F
0023    A7 02               STAA2,X        OUTPUT ROW 7 LOW
0025    86 07               LDAA#$07
0027    E1 00       KEY1    CMPB0,X        TEST IF KEY CLOSED
0029    26 08               BNE KEYFND
002B    0D                  SEC
002C    66 02               ROR2,X         OUTPUT NEXT ROW LOW
002E    4A                  DECA
002F    2A F6               BPL KEY1

     ** NO KEY FOUND **

0031    0C          NOKEY   CLC            EXIT WITH C=0
0032    39          RETURN  RTS

     ** KEY FOUND **

0033    48          KEYFND  ASLA           FORM INDEX WORD FOR
0034    48                  ASLA           ASCII LOOKUP TABLE
0035    48                  ASLA
0036    E6 00               LDAB0,X
0038    4A                  DECA
0039    4C          KEY2    INCA
003A    54                  LSRB
003B    25 FC               BCS KEY2

   ** TEST FOR SHIFT KEY **

003D    C6 FF               LDAB#$FF
003F    E7 02               STAB2,X        OUTPUT ALL ROWS HIGH
0041    64 02               LSR2,X         OUTPUT ROW 7 LOW
0043    E6 01               LDAB1,X        READ COLCTR REGISTER
0045    C4 40               ANDB#$40       TEST IF IRQA2 SET
0047    1B                  ABA            MODIFY TABLE INDEX WORD

   ** LOOKUP ASCII TABLE **

0048    CE 00 6F            LDX#ASCTAB - 1
004B    4C                  INCA
004C    08          KEY3    INX
004D    4A                  DECA
004E    26 FC               BNE KEY3
0050    A6 00               LDAA0,X        ASCII KEYVALUE IN A

   ** WAIT FOR KEY RELEASE **
0052    C6 FF               LDAB#$FF
0054    CE 80 04            LDX#COLREG
0057    6F 02               CLR2,X         OUTPUT ALL ROWS LOW
0059    E1 00       KEY4    CMPB0,X
005B    26 FC               BNE KEY4

   ** DELAY 20 MSEC **

005D    BD E0 DD            JSR DLY 20

   **RETURN WITH ASCII KEYVALUE **

0060    16                  TAB            KEYVAL IN A,B
0061    0D                  SEC            EXIT WITH C = 1
0062    39                  RTS

                ** ASCII LOOKUP TABLE **
0070    1B 32 34 36 38 30 3A 08   ASCTAB  ESC 2 4 6 8 0 : BS
0078    09 57 52 59 49 50 5C 7F           TAB W R Y I P   DEL
0080    00 53 46 48 4B 3B 5D 00           CTRL S F H K ;   HEREIS
0088    00 58 56 4E 2C 2F 00 00            _ X V N , / REPEAT _
0090    5A 43 42 4D 2E 20 0D 00           Z̄ C B M . SP CR
0098    41 44 47 4A 4C 40 0C 00           A D G J L @ CLEAR _
00A0    51 45 54 55 4F 5B 0A 00           Q E T U O   LF _
00A8    31 33 35 37 39 2D 5E 00           1 3 5 7 9 -   BREAK
00B0    1B 22 24 26 28 00 2A 08           ESC " $ & ( _ * BS
00B8    09 77 72 79 69 70 7C 7F           TAB w r y i p̄   DEL
00C0    00 73 66 68 6B 2B 7D 00           CTRL s f h k +   HEREIS
00C8    00 78 76 6E 3C 3F 00 00            _ x v n   ? REPEAT _
00D0    7A 63 62 6D 3E 20 0D 00           z̄ c n m   SP CR
00D8    61 64 67 6A 6C 60 0C 00           a d g j l   CLEAR _
00E0    71 65 74 75 6F 7B 0A 00           q e t u o   LF
00E8    21 23 25 27 29 3D 7E 00           ! # %   ) =   BREAK
```

the PIA. When a key is closed, one row is coupled to one column in the keyboard matrix. By driving one row low at a time until a column is detected as going low, the key closed can be identified. Two 8 bit words are obtained — one with one bit low representing the row containing the key closed, and the other with one bit low representing the column containing the key closed. If the SHIFT key is pressed simultaneously this can be detected by examining the state of the

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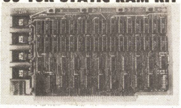

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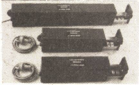

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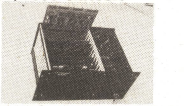

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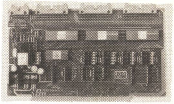

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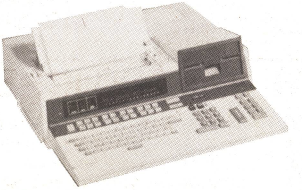

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# SOFTWARE-DRIVEN KEYBOARD

IRQA2 bit in the control register of the PIA after driving row 7 of the matrix low.

All of the keyclosure detection and key identification procedure described above is handled by a software subroutine I have called 'ASCKEY'. When input from the keyboard is required, the main program should call the subroutine, and on returning from the subroutine test to see if a keyclosure was found. If not, the main program should branch back to the subroutine call and continue in the loop until a key is found. It should be noted that the keyboard does not interrupt the main program, and input will be accepted only when the main program is specifically looking for it.

When a key closure is detected during execution or the subroutine, the ASCII code for the key is stored in both the A and B accumulators, and the carry bit in the CC (Condition Code) register id set before returning. If no keyclosure is detected, the carry bit in the CC register is cleared before returning. On returning from the subroutine, a BCC (Branch if Carry Clear) instruction can thus be used to test if a keyclosure was found. As explained above, the subroutine would normally be used in a loop waiting for a keyclosure.

Operation of the subroutine can be followed from the flowchart in Fig. 2, and the program listing and comments. The keyboard matrix scanning is straightforward as described above. Once the keyboard matrix crosspoint closure is found, an index word is calculated to enable a keyvalue table called 'ASCtab' to be looked up to provide the ASCII equivalent for the key closed. The format of the index word is shown in Fig. 3. Bits 0 - 2 represent the column number (0 - 7) and bits 3 - 5 represent the row number (0 - 7), both in binary, in which the key closed is wired. Bit 6 indicates whether the SHIFT key is also closed or not. Bit 6 is cleared if the SHIFT key is not closed, and set to 1 if it is closed. Bit 7 is not used and is always 0.

The ASCII lookup table therefore contains 128 entries — 64 for the keys without shift, and 64 for the keys with shift. The value which should be entered in each position in the table can be easily worked out from the row and column numbers of the key in the wiring matrix and the ASCII keyvalue. Use of this kind of lookup table allows any key to be given any ASCII value. Also codes other than ASCII can be readily substituted if desired.

In the 'ASCTAB' table listing given, the keys are assumed to be wired as in Fig. 1. The unshifted alpha characters are translated to upper case ASCII, and the shifted alpha characters to lower case ASCII. All other keytop designations which fall into the ASCII character set are given their proper values.

As there is no key with carriage return designation on the DSE keyboard used, the key with the blank keytop at the bottom right of the keyboard has been used as carriage return. The keys designated CTRL, BREAK, REPEAT and HERE IS, and the blank key at the bottom left of the keyboard have been given the ASCII null code ($00) and are available for user designation. The CLEAR key has been given the ASCII "form feed" code.

A complete listing of the 'ASCKEY' subroutine is given including the lookup table 'ASCTAB'. The listing gives 6800 machine and assembly language code, and is assembled beginning at location X'000. The subroutine requires less than 256 bytes of memory. It can be relocated simply by changing the start address of the 'ASCTAB' lookup table. The only reference to 'ASCTAB' requiring change is in the IDX instruction at X'0048.

It was mentioned earlier that the CTRL key was wired as an ordinary key in the keyboard matrix. If it is desired to give the CTRL key its usual function as an additional shift key, this could be done by wiring it in row 7 of the matrix and to the CA1 line of the PIA. The lookup table would have to be expanded and the state of the CTRL key indicated in the table index word by bit 7.

So there it is — a very simple, cheap and flexible way to add a full size ASCII keyboard to your Motorola 6800 D2 kit. For those who have a different microprocessor system, the principle of operation and the software can readily be adapted to suit almost any system. When teamed with my software driven ultra-low cost VDU published in the August/September 1978 issues of EA, you have about the cheapest possible keyboard/display combination, yet one with adequate facilities for most hobbyist users.

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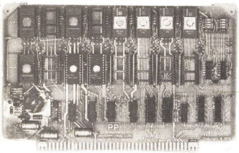

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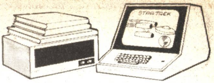
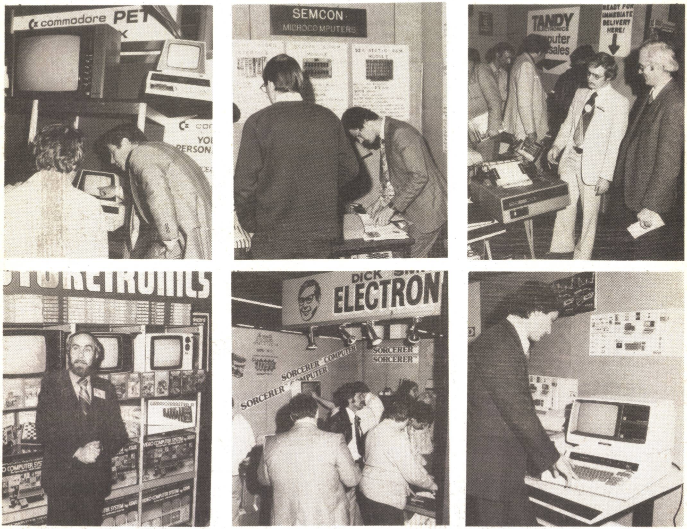
# Microcomputer News & Products



## Sydney's Home Computer Show a roaring success



*TOP LEFT: The Commodore PET section of the Hanimex stand. TOP CENTRE: Dr. John Griffits on duty at the Semcon stand. TOP RIGHT: TRS-80 marketing manager Ken Allen shows EA editor Jim Rowe the new Tandy printer. LOWER LEFT: A confident Peter Alpar at the Futuretronics stand. LOWER CENTRE: The crowded Dick Smith stand. LOWER RIGHT: Sord's M223 mk2 at the Small Computer Co stand.*

Despite some initial confusion regarding the dates on which it was being held, the Home Computer Show held in Sydney from May 24-27th turned out to be a roaring success. The final attendance figure for the 4-day period was 13,800.

Although many show visitors were members of the public merely curious to see what it was all about, those running stands reported plenty of serious enquiries and firm orders.

Stands of particular interest included that run by Hanimex, which was displaying the Commodore PET system and also the Lexicon hand-held language translator; the Tandy stand, which was demonstrating the TRS-80 line printer and low-cost "quick printer"; the Futuretronics stand, where visitors could play a variety of intriguing games; the Computerland stand, where Apple systems were running hand-writing analysis and foreign language pronunciation testing programs, and the Semcon Microcomputers stand, where that firm's impressive S-BUG debugging monitor for 6800 systems was being demonstrated.

Other stands of interest were that run by The Small Business Computer Co, which was demonstrating the Sord model M223 mark 2 system and the M100 "ACE" system with colour graphics facilities, the stand run by A.J. and J.W.Dicker Pty Ltd, featuring the Vector Graphic "System 3" and "Memorite" word processing system, and the Dick Smith stand featuring the Exidy Sorcerer.

Spurred by the Show's success, the organisers are now planning the next one for Melbourne. It is to be held at the Kew Civic Centre, on October 5-7th.

# Microcomputer News & Products

## 64K PROM card

A new PROM card from Pennywise Peripherals can accommodate any mixture of 1K, 2K or 4K byte devices of either the single or triple supply variety; Up to 16 devices may be mounted on the card, giving a maximum card capacity of 64K bytes. An on-board switching regulator is used to derive —5V from the external —12V line.

To simplify addressing and reduce the amount of processor memory space taken by the card, it provides on-board bank selection under software control. The card effectively occupies only two 4K blocks in memory space, and any 4K block on the card can be software selected to occupy either block. The RM-32 card is thus ideal for storing a library of useful software.

Control logic on the card is easily adapted to run on a variety of microprocessors such as the 8080/5, 2650, 6502, and SC/MP as well as the M6800.

Further information from Pennywise Peripherals, 19 Suemar Street, Mulgrave, Victoria 3170. Telephone (03) 546 0308.

## S100 video card

A new S100 video display board from Matrox Electronic Systems is claimed to solve the classic memory contention problem common to all software-driven display systems. The ALTR-2480 board offers a new approach called "Transparent Memory", whereby both CPU and CRT controller can access the refresh memory at any time without either slowing the CPU or producing streaks or glitches on the screen.

The technique is claimed to be applicable to any CPU, and does not rely on the peculiar timing characteristics of any particular processor.

The ALTR-2480 board offers 24 lines by 80 character alphanumeric display, based on a 5 x 7 matrix. A full 128-character set is provided, including lower case and limited graphics. The board features memory mapped addressing, and requires a single 5V power supply. A compatible family of graphics controller cards is also available, with resolutions up to 512 x 256 points.

Further information on the ALTR-2480 and other Matrox products is available from Measuring and Control Equipment Co Pty Ltd, P.O. Box 78, Epping, NSW 2121.

## APOLOGY

The organizers of the Sydney Home Computer Show wish to extend a public apology to all readers of Electronics Australia who were inconvenienced by the incorrect show dates printed in the May issue of the magazine. The original dates for the show were 17-20th May 1979. When the dates were moved forward one week all printed materials and advertising copy were adjusted. The only advertisement overlooked was that in the May issue of Electronics Australia (readers of the April issue will see the dates in that issue were correct).

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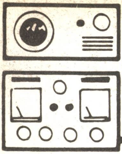


# The Serviceman

## How simple faults can create complex symptoms

**Faults which are, in themselves, relatively simple can sometimes produce the strangest symptons; symptons which can be both misleading and frustrating. I have two stories this month which emphasise this quite strongly, as well as the fact that there is always something new to keep us on our toes.**

The two stories both concern the same model set — though not the same individual set. They were both the HMV model C221; in most respects a very reliable set and one with a high order of performance. However, there are few models of any brand which don't have their individual weak points; points which most of us quickly learn to recognise after we encounter the first one. If you haven't already encountered these in this model, I suggest you make a note of them.

The first problem was one of intermittent sound and, like all intermittent faults, it had proved both elusive and frustrating. The first time I struck it I tracked it to the 14 pin plug and socket assembly from which the various leads run to front panel controls and the speaker. It appeared to be the culprit on the simple basis that wobbling the assembly could — sometimes — create the fault.

In addition, this assembly carries the sound at two levels; into and out of the volume control via P/ST1 (active), P/ST2 (moving arm), and P/ST3 (chassis), and to the speaker via P/ST11 and P/ST12.

Examination of the plug and socket pins did not reveal any obvious faults, but I went over them carefully and made sure they all appeared to be mating correctly. Finally, I gave the whole combination a squirt of cleaning fluid.

This seemed to cure the problem, but I was not entirely convinced that I had really found the fault. To be on the safe side I warned the owner accordingly and asked him to let me know how it went.

A few weeks later, when I happened to encounter him by chance, he answered my obvious question by saying that it had still happened on a few occasions, but that he thought that it happened less frequently than before.

When I offered to have another look at it he suggested that we leave it for a while, since he didn't want to be without his set at that time.

I didn't press the point because I was still puzzled. His impression that it was happening less frequently cut no ice as far as I was concerned; a fault either exists or it doesn't exist; there is no in-between.

It was not long after this that I encountered another set with the same fault. Once again the socket seemed sensitive to movement and once again I checked the pins and applied cleaning fluid, and once again I warned the owner that I was not sure that I had found the fault.

This time I didn't have to wait long for a reaction. He was on the phone in a couple of days with the report that it was little better than before. This removed any lingering doubts that I had regarding the problem; it was obviously a sticky one and not likely to respond to normal treatment. Rather than continue to bash my head against a brick wall, I decide to seek outside help.

I had two sources in mind; the manufacturer's service department, and a colleague who I knew had handled a lot more of these sets than I had. I decided to call him first.

As I had hoped he had also encountered the trouble, but his tally was nearly a dozen chassis. Like me he had tracked the trouble to the plug and socket assembly, had gone through essentially the same motions as I had, and had achieved the same results — or lack of them!

Most of his cases had been encountered after he found the true cause because, like me, he became very suspicious after the first few encounters and had done what I had planned to do — take it up with the manufacturers.

Getting onto the phone to the service department he eventually found someone who knew about the fault and who immediately nominated the plug and socket he already suspected.

"But", protested my colleague, "I've already been over these plugs and sockets and cleaned and tightened all the pins. I can't see how there can still be anything wrong."

"Quite right," replied the technician, "but the fault is not in the mating of the pins, it is where the cables connect to the pins."

He went on to explain that these cables were not soldered to the pins; they were crimped. This is a system which is being used increasingly in the electronics industry, and is also to be found in automotive electrical wiring. The idea is that the lug on the pin or contact is designed to be crimped with either a hand tool or simple press and is so designed that it penetrates the insulation and bites into the conductor.

The system has obvious advantages from a production point of view; no need to strip the wires, with the ever-present risk of damaging the conductor, and no need for a soldering process involving a skilled operator. Unfortunately, in solving one set of problems, the system may well introduce others if everything is not just right.

Which is what seems to have happened in this case because, after even a short time in the field, a significant number of these joints gave trouble. And, to make matters worse, the plug and socket is of a type which cannot readily be taken apart. Once the pins are inserted into the plug or socket housing they lock themselves in.

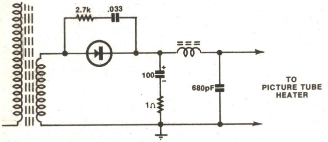
In fact, the pins can be removed by using a special tool available from the set manufacturer's service department. My colleague was interested at first, until he learned the price — twenty six dollars! Then his strong Scots ancestry came to the fore and he said he would think about it.

He did too, but not with the idea of buying it. Instead he and his offsider tackled the job themselves. They made their own special tool; not to remove the pins, but to crimp them in situ.

They did this by grinding down a pair of pliers to a very fine point; fine enough to go into the pin opening in the rear of the plug or socket, grasp the offending lug, and squeeze it hard. According to my colleague he has treated all his offending sets in this way, and not one of them has given any further trouble.

Right now I'm arranging to borrow it to treat my own sets.

One of the surprising aspects of this fault is that it seems to have been confined to the sound circuit, in spite of all the other circuits routed through the plug and socket. Granted, both input and output circuits are handled, thus increasing the risk, but it seems strange that no other circuits have been effected. My theory is that the fault has invariably involved the relatively low impedance speaker voice coil circuits, where a moderate order of spurious resistance can have quite a marked effect.



*The CRT heater supply section of the 221 siwtched mode supply. Failure of the resistor in series with the 100uF capacitor caused some head scratching before it was tracked down.*

The other story concerning this model set also comes from a colleague, in this case one who works in a large service organisation. As is usual in such places there are a number of technicians of limited experience who are often the first ones to tackle a job. In most cases, if it is a routine fault, they can handle it on their own. On the other hand, if it turns out to be a nasty one, they may call in one of the more experienced staff members.

In this case the customer had complained about limited brightness. A junior staff member was sent out to examine the set in the customer's home and quickly confirmed the above mentioned symptoms. In addition, he noted that any attempt to increase the brightness resulted in noticeable defocussing.

He checked the focussing circuit and replaced some components which seemed marginally suspect, but this had no effect. At this point he diagnosed low emission in the picture tube; a quite reasonable conclusion from the symptoms. So, the set was returned to the workshop to have a new tube fitted. (The set was still under warranty, by the way).

The only snag was that, having fitted a new tube, the symptoms were exactly as before. Considering the work involved in fitting a new tube, and adjusting the convergence and other circuits, such a situation must have been disconcerting to say the least.

Anyway, at this point my colleague was called in to solve the mystery. And after spending some time chasing red herrings up blind alleys (ouch!), he finally twigged what was wrong. As is so often the case, the fault lay in a section which everyone had taken for granted; the picture tube heater supply. Instead of the normal 6.3V it was closer to 5V.

That much established, it was necessary to find out why. The model 221 uses a switched mode power supply, with a number of secondary tappings, one for the picture tube heater. This supply is rectified and filtered before being applied to the heater, no doubt to prevent the switched mode frequency from finding its way into adjacent video circuits via either the wiring or picture tube capacitances.

The output from the switched mode supply is adjustable and, since the voltages at all tappings are related, it is normal to check the voltage of one rail only, the 159V rail, adjust the level if necessary, and assume that all other voltages are correct. My colleague checked this aspect of the system, and found all in order.

The next step was to back track from the actual heater terminals on the tube to the output of the filter network in the power supply. The voltage was still low at this point, ruling out things like dry joints etc in the run to the tube.

According to the circuit, the filter network consists of a 100uF capacitor to chassis, an iron core choke in series, and a smaller by-pass to chassis on the other side. But, my colleague pointed out, there was another component, not shown on his circuit (nor on mine). This was a 1 ohm, 2W resistor between the 100uF capacitor negative terminal and chassis; apparently added to limit the ripple current in the capacitor.

And this was the culprit. It was not a wire wound type, as might be expected, but a carbon composition type, and it had gone high; something like 15 ohms rather than its true value.

Naturally, the capacitor was no longer able to do its job properly and the current trying to find its way through the choke contained far more ripple than was intended. Equally naturally, the choke didn't like it, and showed its displeasure by increasing its opposition to the flow of current.

In addition, the capacitor would no longer be able to charge close to the peak voltage value, as it normally does, and which contributes to the voltage which the filter system ultimately delivers.

Once found, the cure was simple enough, but nobody was very happy about the time wasted fitting the new picture tube. Except, perhaps, the customer. He scored the new tube, because it was not worthwhile swapping the tubes yet again.

But, with the wisdom of hindsight, the moral is obvious. It is not sufficient to look at the tube heater, confirm that it is alight, and therefore assume that it is being properly energised. When a tube is suspect the heater voltage should be checked along with all the other operating voltages. This is particularly so when it is being fed from something like a switched mode power supply.

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# Classical Recordings

Reviewed by Paul Frolich

## Hindemith & Janacek: "lively and very colourful music"

**HINDEMITH — Symphonic Metamorphoses on Themes of Weber (1945).**
**JANACEK — Sinfonietta (1926) London Symphony Orchestra, conducted by Claudio Abbado. WRC (Decca) Stereo R.04247.**

It is rather curious that this recording of two of the century's best and most accessible masterpieces should appear on the World Record Club's list only now, some eleven years after the original Decca issue. Stranger still when one realises that neither of these works is in the regular repertoire of recurrent releases; however, it is fortunate that this issue is now being made and that members of the World Record Club can get to know this remarkable music, in first-rate performances.

The Hindemith work is one of maturity (he lived from 1895 to 1963) and the happiest, I think, of his major orchestral compositions. A composer generally held in awe by listeners because of his seriousness, often earnestness, profundity and musical intricacies, can he be found in splendid good humour, cheerful and witty, wholly entertaining.

It may be that the apparent return of peace to Europe raised Hindemith's spirits unduly; whatever the reason, this lively and very colourful music is bound to give pleasure. The reference to Weber is not particularly meaningful and there is little point in pursuing it through the score.

Far more immediately enjoyable is the little tune on which the delightful second movement relies and which is of allegedly Chinese origin; the connection with Weber here is simply in the fact that he used it for incidental music to the first "Turandot" play. In Hindemith's version it leads to all sorts of charming ideas, including some jazzy ones.

The whole of the piece abounds in simply splendid scoring; the first movement is excited and exciting, the third uncommonly delicate and tender and the 4th, a rousing March, a little reminiscent of Mahler at his best. The playing of the virtuoso score leaves nothing to be desired and Abbado's direction is quite excellent.

It might be noted that the record cover shows the work as dating from 1945; the annotations mention 1943 and claim first performance, under Rodzinski, in 1944. My information suggests that 1944 is correct for both completion and premiere.

Janacek's Sinfoniette is a surprisingly suitable coupling which Szell, in his Cleveland recording some years back, also resorted to. Although Janacek lacked Hindemith's sophistication and wide acceptance, his music is at least as original and, in my experience, very exciting and easily assimilated. Abbado's reading of the score is a strongly personal one, but wholly valid and very interesting throughout. He probably performs a useful service by presenting Janacek as being part of the wider stream of European music, rather than stuck away in his little Moravian backwater.

To one who loves the Sinfonietta, and knows it well, this recording comes as a surprise to be savoured; anyone less familiar with this very lovely music might be well advised to seek an opportunity of hearing Kubelik's interpretation as well as this one. Playing and record quality are out of the top drawer.

☆ ☆ ☆

**BRUCH: Violin Concerto No. 1, op. 26.**
**LALO: Symphonie Espagnole. Pinchas Zukerman, violin and the Los Angeles Philharmonic, conducted by Zubin Mehta. CBS Stereo Disc SBR 235964.**

As was the case with the Beethoven 7th, CBS have managed to have this released overseas before the US issue, the packaging is luxurious and the notes differ widely in their three languages. These works are certainly not major classics; they are justly favoured by fiddlers and in many cases are well worth hearing, but I wonder whether they warrant all the musicology that is being accorded to them. That they are less important than a Beethoven symphony is evidenced by the fact that there are currently only eleven other versions of the Bruch and a mere five of the Lalo work in the US catalog.

As both these works are acknowledged show-pieces calling for both virtuosity and judgement, they are usually recorded by great masters of the violin and rarely receive other than first-rate performances. Zukerman, as might be expected, is every bit as good as anyone else and, seemingly, just that little bit better.

Hearing him live, and in several televised appearances in Europe last year, I had become a trifle weary of his excessively lush tone on those occasions. Zukerman, it seems, is one of those virtuosi who tend to over-react to their audiences: the more obviously adoring, and uncritical the paying gentry in the hall, the more he tries to beguile them with his undoubted showmanship. In the studio, luckily, he behaves quite differently.

The Lalo work is the larger one; though Lalo was French, he had Spanish ancestry and the "symphonie" espagnole, which is really a violin concerto, is Spanish in feeling and in many of its rhythms, even though none of the material is actually of folk-origin. Zukerman's reading is intensely romantic, but governed by tasteful restraint, and he is in perfect agreement with the conductor in every firm and determined detail.

I think his performance is much more delicate than was Stern's in the same coupling of these works, and superior to both the lovely old Francescatti recording or the sparkling recent one by Perlman with Previn and the LSO. Finally, these things come down to questions of personal taste, but I think Zukerman's is the most "Spanish" of all the readings known to me.

## CLASSICAL RECORDS

Julian Russell, who prepares our monthly review of classical recordings, was taken ill, involving a stay in hospital. He is now recuperating but, until he is well again, his column will be taken over by Paul Frolich.

The Bruch concerto takes up the balance of the second side. It is as marvellously played by both orchestra and soloist, though the achievement here seems less remarkable. In places, particularly in the velvety slow movement, the violin's tone is so utterly delicate as to almost fade out; in fact, the soloist, far from being over-amplified, may be a bit hard to hear on some pieces of cheaper equipment.

The recording, as a whole, is a great achievement and anyone who does not already own one or more satisfactory versions of these works (and "satisfactory" is a very flexible term) would be well advised to consider adding this one to their string collection.

☆ ☆ ☆

## Melbourne Symphony Orchestra

**MALCOLM WILLIAMSON — Sinfonietta for Orchestral (1965). ROBERT HUGHES — Synthesis (1969); Suite: The Forbidden Rite (1962). Melbourne Symphony Orchestra, conducted by Yuval Zaliouk and Willem van Otterloo (Synthesis). RCA Red Seal Stereo Disc VRL 10192 (ABC recording).**

This record will probably be classed as "Australian" music; although Hughes is English-born, he has spent all of his working life in Australia. Williamson, on the other hand, currently Master of the Queen's Music, has lived in England since his early twenties, except for a season spent here on an ANU Creative Fellowship and occasional visits. For a time in the 1960s at least, he went to some pains to disclaim any Australian connection and he has certainly made good without too much help from this end.

Hughes' music is, as usual, unproblematical and quite easy to cope with. Synthesis, according to the sleeve-notes, was intended as a showpiece for the MSO and grew beyond that. It is a brisk work, full of colour and colouring, brightly scored and thoroughly conventional.

I found the music to be a little ceremonial, pleasant throughout and utterly non-memorable. It clearly suited the late Mr van Otterloo's stolid temperament by its lack of excesses and is here very well played and excellently recorded by the Melbourne technicians.

Hughes' other work, Forbidden Rite, was perhaps the first specially written TV ballet and I found it quite worth hearing although it, too, is thoroughly conventional and derivative. The Suite opens in the manner of Delius and there are references to Stravinsky and others, intelligently and tastefully used. The music alternates between pretty and dramatic and I have no doubt that it is very suitable for TV choreography, particularly in the very evocative "oriental" sections.

I am, however, somewhat bewildered by mention of eroticism in connection with any of the music — unless, that is, one is prepared to equate "erotic" with louder and faster.

In this work, as in the Williamson, the orchestra is conducted by an apparently quite brilliant conductor. I had never heard of Mr Zaliouk; there is not a word about him on the sleeve and it took quite an effort to winkle out some information about him from the ABC.

Zaliouk, now 37 years old, is an Israeli trained at Guildhall and elsewhere, with a very impressive string of qualifications and of very wide experience; apparently, he worked only in Melbourne, having taken over an engagement of Rieger's which was cut short by the latter's illness. I think it is deplorable that his standing and brilliant career have not been acknowledged by the makers of this disc — without him it would have sounded pretty flat and dull!

Williamson's Sinfonietta is here heard in a revised form, said to date from 1975 when the work was to be used for a ballet and required a Prelude to be added to the original three movements as first conducted by Sir Adrian Boult. I do not, usually, care much for this composer's work, much of which I've found to be trite.

But on this occasion we get to hear an utterly different Williamson. Though the music is easy enough on the ear, it is far from being superficial; the powerful Toccata is followed by a rich Elegy, attractively scored and very melodious, and with a fine percussive ending. The Tarantella is perhaps a bit monotonous, but fair enough.

The performance of this music is very fine indeed and shows the Melbourne orchestra to be capable of great deeds. My only reservation is about the stereo; a brief check on the Tarantella suggested that both channels carry exactly the same sound and better separation would, no doubt, have helped to make the music more interesting.

## Zoltan Kodaly — Hary Janos Suite

**ZOLTAN KODALY — Hary Janos Suite, with John Leach, cimbalom; Symphony C major (1961); Minuetto Serio. The Philharmonia Hungarica conducted by Antal Dorati. Decca/WRC Stereo Disc R. 04232.**

This collection of Kodaly's orchestral music is certainly well worth the effort. The Suite from Kodaly's successful opera, Hary Janos, was arranged by the composer in 1927, a year after the opera's premiere. It is full of enchanting tunes and memorable musical quips; since it is the kind of music orchestras and conductors like to show off with, and as it is extremely popular with concert audiences as well, we need not be surprised at the numerous recordings made of it. Both Solti and Kertesz have done the piece extremely well and I'd say that Dorati wins by only the narrowest of margins.

What particularly pleases me about this performance of the Hary Janos Suite is its apparently authentic Hungarian flavour, but I cannot help being puzzled by a player of the cimbalom, the Hungarian instrument par excellence, at the hands of a man with so English a name. Never mind, he plays it splendidly! Truly, this is a grand performance and the best one can expect under the circumstances, I think: a suite is all very well, but it really does not measure up to the opera and I regret that it is so freely accepted as a substitute for the full work.

The Minuetto Serio, which occupies the final section of side one, is new to me; it is an extract from an opera Czinka Panna, first performed in 1948 and promptly withdrawn "because of problems connected with the libretto" — presumably problems of a political nature since the libretto was filled with red-hot nationalism. It is an imaginative piece of music, strongly evocative of the courtly past and thoroughly attractive. It is played with great love and attention to detail; one might wish that more of the score to this opera could become available. As Dorati was a pupil of Kodaly's, and remained close to him, we need have no doubt as to the authenticity of his interpretation in any of this music.

The Symphony, dedicated to the memory of Arturo Toscanini, was Kodaly's last major work. It was first recorded by Janos Ferencsik in 1966 and Dorati's 1974 recording is the only other one made as yet. I had not heard the work before and find it to be one worth knowing; it is by no means difficult to sit through, strictly tonal and its complexities are more apparent than real.

The first movement, a short Allegro, is partly heroic, partly shrouded in tender mystery; the second, Andante moderato in three sections, tends towards noble thoughts and the Vivo finale contains most of the meat. It is full of dance, happy shouting and gaiety.

This symphony is the kind of work which has a fair prospect of entering the repertoire of orchestras anywhere, once it gets known. It is always possible that better performances and better recordings of a work, or a group of works such as these, will come along later; in this instance, I very much doubt it.

... full of enchanting tunes

# Lighter Side

Reviews of other recordings

## TARZAN LIVES AGAIN — BY COURTESY OF ASTOR RECORDS

**Astor Records have recently turned back the clock with the release of a whole batch of albums and cassettes containing segments of one-time top-rating American network radio shows. While not all of them may have been heard directly in Australia, they are nevertheless an authentic reminder of the "golden days of radio".**

The albums will be of special interest for those who shared the pre-television era, when radio was an almost universal source of entertainment in the home. For younger people, the experience of having to create one's own mental images for "picture-less television" may be something new!

One album which will require a minimum of re-orientation features the unique voice and personality of Bing Crosby:

**THE BING CROSBY RADIO SHOWS. Original radio broadcasts. Mono, Astor GA-5023.**

Whatever else might be said about Bing Crosby, one thing is certain: he was timeless. Here, in the 1940's, he is the same mature, relaxed performer as ever.

As distinct from a single "episode", this album is made up from cuts of his many broadcasts and features appearances by a variety of guest artists: Jimmy Durante, the Andrews Sisters, Burl Ives, George Burns, Maurice Chevalier, Bob Hope, Judy Garland, Humphrey Bogart & Lauren Bacall, The Mills Brothers, Peggy Lee, Nat King Cole.

Incidentally, the jacket notes point out that Crosby was one of the pioneers of pre-recorded transcripted shows and these are well recorded excerpts from the Crosby collection. Snippets, but historic and interesting!

The next one is completely different in character:

☆ ☆ ☆

**YOU BET YOUR LIFE. Groucho Marx. Two complete radio shows. Mono, Astor GA-5021.**

Despite his effectiveness on the cinema screen, Groucho Marx was, for a long time, a seeming failure on radio. He was never comfortable working to a script and producers were wary of his ad-libbing. All that changed when producer John Guedel deliberately discarded scripts and gave Groucho his chance with a completely ad-libbed comedy quiz show. Premiered in October 1947, it ran for three years on NBC radio and for nine more on television.

Although they belong to a past era, the two 15-minute quiz shows on this album stand up quite well and they're collector's items on that account. But one more observation should be made: It's precisely the formula that the late Jack Davey had already developed and established on Australian radio!

And now for some "whodunnits", by way of a change.

**SHERLOCK HOLMES. Two original 30-minute broadcasts, "The Dying Detective" and "The Empty House". Mono, Astor GA-5030.**

According to the jacket notes, Sherlock Holmes and Doctor Watson first made it on the American radio scene in the late 20's, scripted by Edith Meiser and broadcast by the NBC network. When Arthur Conan Doyle's original stories ran out, more written in his style, sufficient to support the series for 49 years!

The age of the present two episodes is not stated but they feature Sir Ralph Richardson as Dr Watson and Sir John Gielgud as Sherlock Holmes.

Reflecting the Holmes era — and early radio drama — the episodes open in a casual, wordy way, giving the less gifted participants (and the armchair listener/detectives) an opportunity to predict the last-minute, brilliant deductions of the master!

The many devotees of Sherlock Holmes should enjoy it.

For a whodunnit in a completely different style, Astor also offer:

☆ ☆ ☆

**DRAGNET featuring Jack Webb. Two complete 30-minute stories. Mono, Astor GA-5003.**

Premiered in July 1949, each episode of "Dragnet" opens with a theme that you will recognise instantly, and with narration as sparse and as clipped as Holmes/Watson dialogue is tireless. By way of further contrast, Dragnet stories are allegedly based on contemporary fact from the Los Angeles police files, while the Holmes episodes are fiction of another era set in London. The two albums have been commandeered by another member of my family as contrasting examples of style in radio drama!

A still further style variation in American crime radio drama is exemplified by another album:

☆ ☆ ☆

**GANGBUSTERS. Two complete 30-minute stories. Mono, Astor GA-5005.**

As distinct from the verbose style of Holmes and the clipped phrases of Jack Webb, Gangbusters comes closest to the conventional format for radio plays — a minimum of narration, normal dialogue with built-in action clues, and

generous sound effects. First put to air in 1936, it ran for 20 years and was then syndicated all over again. A reference in the script dates "The Golf Course Murder" as 1946. The other store here is "The Case of the Chicago Tunnel Gang".

Curiously, "Gangbusters" invited a lot of criticism during its more recent run because it was too pro-police!

From crime busting in American cities, another Astor album whisks us half-way round the world to the African jungle.

☆ ☆ ☆

**TARZAN. Two stories: "None So Blind" and "Killer At Large". Astor, Mono GA-5005.**

In Killer at Large, an escaped convict has killed a noble white judge and his family, touchingly revered by coloureds and whites alike. The authorities can find no trace of the culprit and are at their wits end when Tarzan of the Apes, blessed with the most cultured voice of the whole assorted bunch, undertakes to bring the criminal to justice. As it works out, Tarzan is spared the necessity for violence but the "baddy" cops it, nevertheless.

Tarzan first went to air in 1932 and, after 3 years and 350 episodes had exhausted all the available story lines from Edgar Rice Burroughs, plus a lot of others from elsewhere. The series enjoyed a nostalgic re-run in 1952 but, by then, the attitudes and characters imputed to colonial Africa had become even less credible than the figure of a cultured, gentle giant swinging through the jungle treetops!

Speaking of creditility gaps, that brings us to:

☆ ☆ ☆

**GENE AUTRY'S MELODY RANCH. Three complete shows. Mono, Astor GA-5012.**

The album opens with the 15-minute session which was intended as a promotion for the first "Melody Ranch" — next Sunday night, January 1, 1940, over the CBS network. It drips with schmaltz as Gene Autry is presented as the clean, wholesome American boy, typifying all that is good and commendable in American society . . .

After some heavy promotion of Wrigley's gum, the first show settles down rather better than one might expect from the promo, with a mix of western dialogue, western songs and a bit of lightweight western drama. In fact, the whole show is lightweight and I wasn't upset to reach the wind-out, by courtesy of Wrigley's "genu-whine" spearmint gum!

To round out the collection under review is an album of "genu-whine" American soap opera:

**THE RIGHT TO HAPPINESS. Four 15-minute episodes. Mono, Astor GA-5016.**

There is no orchestra to set the mood for these episodes; just a lone Hammond organ to play the theme and to underlay moments of emotion with its lingering tremulant. The small cast takes its time over the dialogue, in the sure knowledge that there'll be next day, next week, next month, and next year to work out the present agony. I'm no expert in soap opera, American or Australian, on radio or television, but they seem ever to be thus.

Curiously, these episodes must have been towards the end of the 21-year run, which faded out with Carolyn in the arms of husband number 5, in November 1960. The appended commercial is for 4-speed stereo hifi, but the sound quality of the recording is belongs strictly to the realm of 1-speed mono low-fi!

But don't let me put you off. You can still hear the sobbing and the sighing!

I gather that there are something like twenty albums in the series, to date, including such other titles as "The Shadow" (Orson Welles), "The Lone Ranger", "Gunsmoke", "Captain Midnight", "Flash Gordon", "Superman" (the first four episodes), "Popeye The Sailor", etc.

Enough to set up your own period radio station!

## OTHER ALBUMS

**PYRAMID. THE ALAN PARSONS PROJECT. Arista stereo SPART-1054. Also available on cassette. An EMI release.**

I first came across this album some time ago, when doing the story for our November '78 issue on the new EMI studios. Alan Parsons, a leading exponent of modern and electronic music had visited the studios and expressed his intention of availing himself of their outstanding technical facilities. EMI engineers, in turn, were unstinting in their praise of his abilities, as revealed in this latest release. Listening to the sensitivity of the mix-down, the quality and the use of the stereo dimension, I can understand why.

But, after a relatively slight encounter with the Alan Parsons Project, I don't pretend to understand the relationship between ancient pyramids, simulated mummies, space ships, integrated circuits and the sometimes introspective lyrics: What Goes Up — The Eagle Will Rise Again — One More River — Can't Take It With You — Pyramania — Shadow Of A Lonely Man.

Superficially, its modern but restrained, leading to one description I have seen of "mood music for the seventies". But Im sure that there's a lot more

## New Devotional Records

**THE PSALMS OF DAVID, VOLUME I. World Record Club WRC 02803.**

King's College Choir, Cambridge, is probably the world's best choir, at least as far as Anglican liturgical music is concerned, and this record from the World Record Club's excellent series of Church music is a good showcase of their skill.

The versions sung are according to the translation by Bishop Coverdale and first appeared in the early sixteenth century. They were sung, morning and evening in 30 day cycles; hence the last track, for the 30th evening has the last four Psalms. Others sung are 122-42-43-104-61-24-121-23-46-84-15-137. You don't miss a word, so good is the diction of the choristers and the balance of the recording. The conductor and organist was David Willcocks. Recommended for those to whom the music would appeal. (N.J.M.)

☆ ☆ ☆

**LOVE EYES, Jamie Owens-Collins. Stereo, Light Records LS-5736. (From Sacred Productions Aust., 18-26 Canterbury Rd, Heathmont Vic. 3135.**

If you saw this album on the display rack, you'd probably take it to be a program of sentimental love songs. You'd be half right. The themes are indeed sentimental but they relate to Christian devotion, as expressed by the blond lass on the cover, Jamie Owens-Collins:

Love Eyes — Daniel — Radio Man — Hidden Treasure — It's Been Quite A Year — Only You — New Day — Waters Of Rest — Mighty River.

As you've probably gathered, this isn't an album that you'd buy for stirring Gospel themes. Rather it is a gentle expression of Christian and human devotion, ending with an invitation to the listener to identify with the values communicated by composer and soloist Jamie Owens-Collins.

The accompaniments range from gently rhythmic through to soft rock, and the sound is uniformly clean and well balanced. The lyrics appear infull on an inner sheet. A pleasant interlude. (W.N.W.)

Reviews in this section are by Neville Williams (W.N.W.), Jamieson Rowe (J.R.), Leo Simpson (L.D.S.), Norman Marks (N.J.M.), Greg Swain (G.S.), and Danny Hooper (D.H.).

## LIGHTER SIDE — Cont.

to it for those who want to seek out what Alan Parsons is trying to communicate. Mood music in a different sense? (W.N.W.)

☆ ☆ ☆

**THE VERY BEST OF SANDY NELSON. United Artists L 36564 Festival release.**

This album fron American drummer, Sandy Nelson, was originally released in 1962, and the music sounds like it, with the style of playing reminiscent of the early days of 'Rock'. Especially is this so in the guitar style of the un-named backing musicians. Nor is there much stereo information on the disc to spread the sound. The tracks are: Teen Beat — Big Noise From The Jungle — Honky Tonk — All Night Long — Drums Are My Beat — Drumming Up A Storm — Let There Be Drums — Land Of A Thousand Dances — Drums A Go Go — The Stripper — You Name It — And Then There Were Drums.

Apart from the lack of stereo the quality is good. (NJM)

☆ ☆ ☆

**PAUL ANKA . . . HIS BEST. Paul Anka. United Artists. L 36798. Festival.**

Paul Anka has chosen 12 of his best songs for his latest album. He has the ability to communicate the feeling of a song to the listener whether it be happy or sad and I found this album to contain a lot of emotionally warm tracks.

Nine of his best compositions here were recorded under studio conditions and three captured live in concert.

The tracks are: You're Having My Baby — The Times Of Your Life — I Don't Like To Sleep Alone — Everybody Ought To Be In Love — I t Doesn't Matter Anymore — Happier — One Man Woman/One Woman Man — I Believe There's Nothing Stronger Than Our Love — My Best Friends Wife — She's A Lady — Let Me Try Again — My Way.

If a Paul Anka fan, this album is a good collection of his best. (D.H.)

## Vivaldi memorial a sound spectacular

**TO HONOUR THE TRICENTENNIAL OF ANTONIO VIVALDI 1678-1741. Heiichiro Ohyama and the Cremona Chamber Ensemble. Stereo, direct-to-disc. Sonic Arts laboratory series, No. 8. (From P.C. Stereo P.O. Box 272, Mt Gravatt, Qld 4122).**

Heiichiro Ohyama is introduced in the jacket notes as having been born in Kyoto, Japan, and having begun to learn the violin at the age of 5. In 1968 he entered the Guildhall School of Music and Drama in London to study under Julius Katchen. In 1970 he entered Indiana University for further studies, becoming assistant professor at the University of Santa Cruz, teaching violin and viola. He is currently artistic Director of the Cremona Chamber Ensemble at the University of California.

Commemorating the tricentennial of Antonio Vivaldi, the program here includes Concerto "Spring" in E major, Opus 8 No. 1 — Sonata for Violin and Basso Continuo in A major. Opus 2 No 2 — Concerto Grosso for 2 Violins and Violincello and d minor. Opus 3 No. 11.

Whether or not you are familiar with the music, be assured that it is highly listenable. I was happy to listen through it attentively, then play it over again at lower volume while I typed this review. "Music that softer on the spirit lies . . ."

A potent factor in this reaction is the complete transparency in the sound. The impact here is not one of weight or dynamics or, indeed, any kind of overt sonic display. To be sure, the solo violin is perhaps a little too prominent but that's probably a heritage of a recording approach which allows for no subsequent re-balancing by the engineer. The overall impact is of a close-up, lively and accurate performance, unspoiled by any obvious noise or other "system" intrusion. I liked it a lot. (W.N.W.)

☆ ☆ ☆

**BOTTOM END MUSICAL BASS & TRANSIENT TEST RECORD. Stereo, 45 rpm, M&K Sound Inc. (From M.R. Acoustics, P.O. Box 165, Annerley, Qld 4103.)**

Here's an album that could make you happy, discontented, or just plain miserable. As the title suggests, it has been created for one main purpose: to rumble your floor, rattle your pictures, or flap your pants (their suggestions, not mine). It also mixes in an array of transients calculated to unstick your stapes!

Side 1 contains 8 tracks: Cannon from the 1812 overture — Pipe organ & orchestra — Pipe organ & saxophone — Music box with high bells — Flamenco dancers — Player piano with chest organ and xylophones — Bass drum & tympani — Chest Organ.

Side 2 starts off with seven tracks of bass-rich sound, repeated several times to allow loudspeaker systems to be switched for direct comparison. Then follow 5 tracks of the source material for further listening, ending with a steam loco, rumbling across your hearth.

Now for the happiness or misery bit: If the floor, pictures, pants and stapes don't behave somewhat as predicted, you're going to be miserable. If the sound is good but not staggering, you'll most likely start dreaming about a subwoofer to reinforce that pale suboctave. Or maybe you'll start thinking all over again about that 100W per channel amplifier that is less likely to clip.

That's really what this record is all about. It's not intended to be musical or entertaining. Just ear-boggling. A natural for that bowl-em-over sound demonstration.

Direct cut? No way. It's probably been made up from about 57 pieces of tape strung together to provide the requisite number of tracks and repeats. But it was cut at 45rpm and sent to Germany for processing — which seems to be the "in" thing, these days, for the American market.

So go to it, all your masochistic hifi insatiables. (W.N.W.)

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Sure, we 've got all that. Just like the others. In fact, our audio amplifiers, tuners and decks are made in the same factory that produces one of the 'big names' mentioned above. We're not game to mention which one, but it's a fact!

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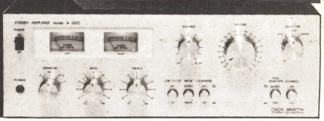

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JAS7879 — 35

# AMATEUR RADIO

by Pierce Healy, VK2APQ

## P & T Minister addresses WIA 43rd annual convention

**The 43rd annual convention of the Wireless Institute of Australia was held in Melbourne on the 28th and 29th April 1979. Matters relating to WARC 79 and possible effects on the future of amateur radio were among the subjects discussed.**

A highlight of the convention was an address by the Hon A. Staley, MP, Minister for Posts and Telecommunications. Delegates were assured by Mr Staley that it was the Government's intention to restrict the installation of channel 5A TV transmitters to those services for which large financial commitments had been made, and confirmed the policy of using UHF channels for ethnic television services.

A number of other complex technical problems associated with the proximity of TV frequencies to international amateur radio frequencies were also discussed and clarified. These problems related particularly to TV channels 0 and 5A.

During his address Mr Staley paid tribute to the WIA for the way in which the Institute had prepared the amateur service case for the World Administrative Radio Conference (WARC 79). He said that the Australian amateurs had been outstanding in setting out their needs and requirements and he was impressed by the way the delegates to WARC 79 had worked in collaboration with his department in preparing Australia's submission to this most important conference.

Refering to continual experimenting by amateurs all over the world, which has led to the development of many new communication techniques, Mr Staley said "we must have diversity in communications, we can no longer rely on traditional means, and the amateur service plays an important role in this regard".

During the 68 years history of the WIA this is the first time that a federal minister has addressed the annual convention.

The WIA, the official representative body of amateur radio operators in Australia, is the oldest amateur radio organisation in the world. Formed in 1910, it predates the United Kingdom by three years and the USA by five years.

Other subjects discussed with the minister included: pensioner licence fee concessions; regulatory matters, including the new handbook and the proposed new radio communication act; definition of TV service areas; and the possibility of a radio frequency advisory committee for Australia to increase awareness of spectrum management.

The discussion format allowed direct questioning of both the minister and his first assistant secretary, Mr J. Wilkinson, who also attended the function. The convention dealt with 34 agenda items, 10 general business items, two special resolutions, 18 annual reports, several routine matters, and detailed explanations relating to WARC 79.

In dealing with the budget for 1979 it was recommended that, subject to review at 31st August, no increase be made in federal dues providing membership of the Institute continues to increase.

The federal executive was authorised to examine the desirability of printing the Australian Amateur Call Book annually.

It was the unaminous agreement that every effort be made to ensure the fullest possible involvement of the amateur radio service in WARC 79. Amateur involvement in succeeding years was also an important factor.

### NORTH QUEENSLAND CONVENTION

The fourth bi-ennial North Queensland Convention, conducted by the Townsville Amateur Radio Club, will be held on 14th to 16th September, 1979. The venue will be the Townsville College of Advanced Education situated in bushland at the base of Mount Stuart, adjacent to the James Cook University, about 11km from the centre of Townsville.

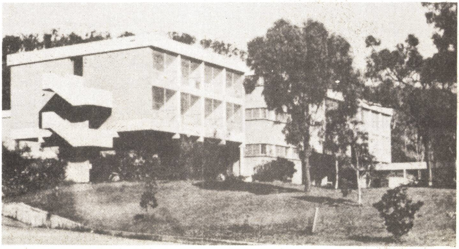
High standard single room accommodation is available at the college at $10.50 per adult for bed and breakfast. Alternate accommodation can also be arranged.

Fees: Registration — single $18; double $32; family $35.

The registration fee includes the convention dinner dance, two lunches, and morning and afternoon teas.

Closing date for registrations is 7th September, 1979. However, registrations received prior to 1st September will be included in a ballot for an early registration prize.

Registration and accommodation fees should be made payable to TARC and sent to — The Convention Committee, Townsville Amateur Radio



*The Townsville College of Advanced Education, venue for the North Queensland Convention conducted by the Townsville Amateur Radio Club. The College is situated in bushland adjacent to the James Cook University, 11km from Townsville.*

# AMATEUR RADIO

Club, PO Box 964, Townsville, QLD. 4810.

For further details join the TARC net — VK4WIT — on 3605kHz on Sunday evenings at 0945GMT. Telephone Peter Snell, VK4APS on (077) 722002, A/H (077) 73 2249.

Ansett Airlines are the official convention airline, and information is available from their convention departments in major cities.

### VK2/ZL 144MHz RECORD

During the unusual VHF opening across the Tasman in January 1979, reported in the March issue of these notes, the distance record between New South Wales and New Zealand was broken.

On the 10th January, 1979, Don Soraghan, VK2PU, at Kingscliffe on the far north coast, worked ZL2BFC/portable at 0734GMT. The record now stands at 2409km.

### TRIAL AOCP EXAM

The August 1979 Amateur Operator's Certificate of Proficiency (AOCP) examination, conducted by the P & T Department, will be the first in the multi-choice format.

To assist candidates preparing for that exam, the Wireless Institute YRS organisers in Victoria have prepared a trial exam based on the new format.

The trial exam will be held, Australia wide, on Saturday, July 7. Papers have been set and the exam will be co-ordinated through WIA YRS and affiliated clubs.

Those interested should contact local amateur radio clubs or Roy Hartkopf, VK3AOH, 34 Toolangi Road, Alphington Vic 3078.

In New South Wales details may be obtained from D. Wilson, PO Box 109, Toongabbie, 2146.

The fee is $1.50 for club or WIA members and $2.50 for non-members.

### RTTY NEWS

Membership of the Australian National Amateur Radio Teleprinter Society has grown to 436 members and the new postal address is PO Box 860, Crows Nest, NSW, 2065.

Their quarterly publication "AREWISE" contains a wealth of information on RTTY technical projects, as well as news on local and overseas RTTY activities.

The society also provides assistance to members in the acquisition of teletype machines, spare parts, and kits for demodulators, filters etc.

News broadcasts are transmitted each Sunday morning at 0030GMT on 7045kHz and 14090kHz. Transmissions are also made on the 80 metre and two metre bands.

Full details of the society's activities may be obtained by writing to the secretary Bob Taylor, VK2AOE, at the address given above.

The South East Queensland Teletype Group has been reformed with the aims of promoting the use of RTTY and the education of amateurs in RTTY techniques.

Towards these aims the group is organising technical lectures for each of its monthly meetings and producing a series of circuits and other technical information for distribution to members.

Weekly news broadcasts are made by a group member on Monday nights at 0930GMT on 146.6MHz and 3540kHz, followed by call backs on phone.

The group meets on the first Friday of each month at the Holland Park State High School, Baupaume Road, Holland Park, commencing at 8.00pm.

Enquiries may be directed to the Secretary, David Barnbaum, VK4ADB, PO Box 274, Sunnybank QLD 4109 or after hours telephone (07) 399 5366.

### SPECIAL CANADIAN STATION

A station to look for from 5th July to 14th July, 1979, is VE6SUN. This station will be operating for ten hours a day, between 1700GMT and 0400GMT, from the Calgary Fair Ground during the world famous Calgary Stampede event. Bands used will be 10, 15, and 20 metres, generally outside the American phone bands.

The equipment will be an FT7 transceiver and a TH3J high gain beam antenna. Apart from participation in the Calgary Stampede event, a special feature will be that the station will be "solar powered", hence the appropiates station call sign suffix.

A special QSL card will be issued for the event which will acknowledge all contacts made with VE6SUN.

(Details from VE6CKD during QSO with VK2APQ).

### RADIO CLUB NOTES

**WAGGA AMATEUR RADIO CLUB:** The club has a membership of 56. Of these, 38 hold amateur licenses and the AOCP course has 15 enrolments.

Wagga WICEN has been active by providing communication for the Wagga Rescue Club during the Gumi Race. This proved to be more than just an exercise as the WICEN operators were called upon to handle a variety of important messages.

**SYDNEY RADIO AMATEUR RADIO GROUP OTC (A):** Formed on the 5th April, 1979, the office bearers are; president Bill Brown VK2IO, vice-president Alex Sandilands VK2BCV; treasurer Don Hitchenson VK2NGF; secretary Gareth Davey VK2ANF and Graham Hansen.

There are 15 members in the group, all OTC personnel. Interest in the club is being shown by other coastal radio stations.

The club call sign is VK2OTC and it is proposed to have a permanent club station in operation for the benefit of members who, because of living arrangements, are unable to set up

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| BSC 6 | 43 mm | 27 mm | 20 mm |
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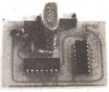
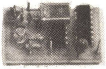
| BSC 22/11 | 54 mm | 48 mm | 26 mm |

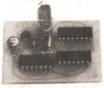
**Crystals for the quartz multiple frequency reference project in this issue are available from Bright Star Crystals.**



Model BSC 11



Model BSC 6

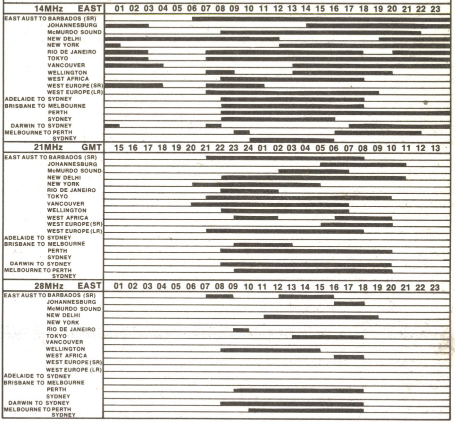


Model BSC 13/22

# AMATEUR RADIO

## IONOSPHERIC PREDICTIONS FOR JULY

**Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Department of Science. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). Black bands indicate periods when circuit is open.** 7.79



their own home based station.

**RAAF LAVERTON AMATEUR RADIO CLUB:** This has been reformed after a period of inactivity and is now on the air under the original call sign, VK3ARC. Although only a small group, the club is reasonably active and looking for contacts. Ted Garnett, VK2CAQ/3 is secretary and the address is PO Box 326 Laverton Vic. 3028.

**DARWIN AMATEUR RADIO CLUB:** If you are visiting Darwin to escape the southern winter, here is the latest information regarding the club. Postal address is PO Box 37317, Winnellie, NT. 5789. The club call sign is VK8DA, the meeting place East Point Reserve the first Monday of the month at 7.30pm. Contact vice-president Barry Burns on telephone 85 1068.

**JESMOND & DISTRICTS ELECTRONIC & COMMUNICATION CLUB:** Four displays of electronic and communication equipment on Thursday nights and Saturday mornings at the Kotara "Garden City" shopping centre in the Newcastle area have been highlights of recent club activities. Leaflets were distributed among the shoppers, resulting in many enquiries from those interested in joining the club. The display was televised by NBN 3 and went to air on Friday morning 4th May, 1979.

In addition to YRS classes a multi-unit course in electronics covering 22 topics is conducted at the club.

Further details from the secretary, John Murphy, 103 Rankin Drive, North Lambton, NSW 2299, or telephone (049) 57 5560.

**EASTERN & MOUNTAIN DISTRICT RADIO CLUB:** At the annual meeting in March 1979, the EMDRC made a very generous donation to the WIA WARC 79 fund.

A cheque for $1000 was presented by the retiring president, Tony King, VK3IO, to David Wardlaw, VK3ADW, WIA federal president. This donation was in addition to $100 previously donated to the fund.

The annual report of the club shows that it enjoys a sound financial position, this being mainly due to a substantial increase in membership and the efforts of the bulletin editor Graeme Hattwell, VK3NGS.

**ILLAWARRA AMATEUR RADIO SOCIETY:** The RTTY mode is being encouraged among members, and a series of articles by Gerry Rosam, VK2APG, will be appearing in their monthly newsletter, "The Propagator".

Moonbounce project co-ordinator, Lyle Patison, VK2ALU advises that a sketch plan for the proposed new operating building has been sent to the University of Wollongong as requested. Also, the University has received approval, from two of the authorities involved, for the installation of the antenna dish and its control building.

**MOORABBIN & DISTRICT RADIO CLUB:** From the report in the March 1979 issue of their magazine "APC" it seems that members participating in the John Moyle Memorial National Field Day had an interesting and rewarding weekend. Operation was on all bands 3.5MHz to 432MHz. Among the contacts noted was one on six metres with New Zealand.

**WESTLAKES RADIO CLUB:**

Classes for the AOCP and novice licence examinations are again well attended. The AOCP classes are held on Monday and Wednesday nights, and the novice class on Tuesday night.

Following discussions with officers of the WIA Contest Committee it appears that the Westlakes Novice Contest could become the Australian Novice Contest under the direction of the WIA.

The purpose of the WNC was to create interest in novice contests. It would appear that the contest is well liked and it has achieved its purpose in the two years it has been running. Now that it is established as an annual event it is in the interests of amateurs generally that the contest be handled by the national society. This will bring national and international recognition and it is hoped that it will feature on the world contest calendar.

If the proposals come to fruition a "Westlakes Trophy" will possibly be instituted to be competed for by participants in the contest.

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Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent to Pierce Healy at 69 Taylor Street, Bankstown 2200.

**SO YOU WANT TO BE A RADIO AMATEUR?**

To achieve this aim, why not undertake one of the Courses conducted by the Wireless Institute of Australia? Established in 1910 to further the interests of Amateur Radio, the Institute is well qualified to assist you to your goal. Correspondence Courses are available at any time. Personal classes commence in February each year.

For further information write to

**THE COURSE SUPERVISOR,**
**W.I.A.**
**14 ATCHISON STREET,**
**CROWS NEST, NSW 3065**

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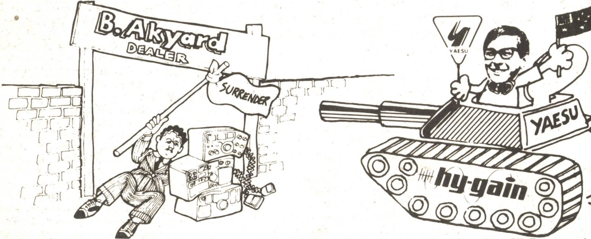

**Dick Smith regrets to announce the passing of an entire unit in the Yaesu Price War. The FT-7 transceiver is no more. Other units are still going strong, some with reduced numbers. Don't miss out – at these prices they could be wiped out! Even the famous FT 227R has had its price ticket shot full of holes. No longer are they $379.00 (reduced from $395.00). Now save an extra $60.00 while they last: only $319.00!**

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## AMATEUR RADIO

# YAESU FT-101Z AND FT-101ZD TRANSCEIVERS

**One of the most recently released amateur transceivers on the Australian market is the Yaesu FT101Z, handled by Dick Smith Electronics Pty Ltd. While carrying on the well established FT101 tradition, it incorporates a number of worthwhile improvements which, at the price being quoted, makes it extremely good value for the amateur who must restrict his investment.**

This latest Yaesu transceiver in the FT101 series incorporates changes which will appeal to many amateurs. Designated as FT101Z or FT101ZD its appearence is almost identical to the FT901 series.

The difference between the "Z" and "ZD" is that the FT101ZD has a digital readout frequency display. Other optional fitments for both are: DC-DC converter, CW filter, microphone, and cooling fan. Interface with the FT901 external VFO, transverters, and antenna tuner is permissable.

In the window provided for the digital display, the FT101Z has an illuminated straight line dial graduated in 100kHz segments from 0 to 500kHz. Indication is by a vertical pointer driven from the main tuning dial. The main tuning dial is calibrated 0 to 100kHz, in 1kHz steps, so that one full revolution of this dial is equal to one division on the vertical dial.

Although these two dials are calibrated in frequency, all the associated controls are calibrated in (metre) bands. As a result the user has to remember and perform a mathematical calculation: band edge frequency, plus the main dial reading, plus the horizontal dial if the pointer shows above 100kHz. The four segments of the 10 metre band marked A,B,C,D, must also be translated when using that band. The digital display overcomes this factor and the readout is in MHz to 100Hz resolution.

The major design change from the earlier FT101 series is the use of the proven 6146B valves in the final amplifier stage. In addition the noise blanker works extremely well, having a variable threshold control which allows adjustment to be made to suit a wide range of conditions. Checks made during very noisy conditions proved that, in conjunction with the IF bandwidth control and clarifier, otherwise unreadible CW signals could be "pulled out of the mud".

The three controls just mentioned were smooth in operation and not critical in adjustment. The IF bandwidth is variable from 300Hz to 2.4kHz and does not change the pitch of the received signal. The clarifier allows an offset up to + or — 2.5kHz of the operating frequency on either transmit or receive, or both.

*The Yaesu FT101Z. Note the linear scale above the main dial, which replaces the digital readout in the FT101ZD. One turn of the knob gives about 17kHz shift on the main tuning dial.*

The unit is well engineered and solidly constructed, covering the 160 metre to 10 metre bands, with a 500kHz coverage on each band, plus WWV/JJY standard frequency on 5MHz.

Rated at 180 watts DC input the unit under review readily loaded to more than 150 watts RF output on CW. The modes are LSB: USB and CW.

On air performance over a period of three weeks indicated that the unit under test was up to the standard claimed in the instruction manual. No laboratory type checks were made, the performance was judged on normal amateur communication requirements under varying conditions, including a continuous eight hour period operating portable at a high school demonstration.

The receiver was quite lively on all bands and all controls, including the dial mechanism, were smooth and positive. The preselect control, which adjusts the RF and IF stages requires adjustment if a frequency change within the same band is made, otherwise there may not be any ALC indication of modulation on transmit. This serves as a warning to the operator to check this.

The frequency stability was found to be very good and drift did not exceed the figures stated in the handbook. Contacts were made with many overseas and Australian stations. Reports on the transmitted audio quality and modulation were very complementary except, initally, on the 28MHz band where the reports were not good. However, tests with another microphone of the same type cleared the problem. Inspection of the original microphone revealed that a strand of one of the leads inside the microphone case was touching a metal cable clamp and presumably causing some obscure type of RF feedback, at 28MHz, through the microphone circuit.

Other facilities provided are VOX and RF speech processor, which operate effectively, side tone for CW operation, extension speaker, wideband IF, and transverter outlet connections. A 25kHz marker signal generator, 10dB and 20dB incoming signal attenuator, and provision for two crystal controlled transceive channels.

The instruction manual gives adequate information on tuning proceedures, also illustrated description of various units and component layout, plus details of installing the digital display and optional fitments. Even so, more technically minded users would probably appreciate a more detailed description of the circuit.

SUMMING UP: The Yaesu FT101Z is an easy-to-operate conventional hybrid type transceiver giving very satisfactory on-air performance at a competitive cost; the optional fitments serving to reduce the cost of the basic transceiver.

However, the wisdom of making the fan an optional accessory may be questionable, and its omission could prove to be false economy in the Australian climate, perhaps leading to shortened life for the output valves.

The unit reviewed was supplied by Dick Smith Electronics. The price quoted for the FT101Z was $775 with optional extras — cooling fan $12.50; microphone type YE7A $14.50; DC-DC converter $85. (PJH-VK2APQ).

# SHORTWAVE SCENE

by Arthur Cushen, MBE

## Broadcasters could lose listeners by using higher frequencies

**The increasing sunspot count is forcing stations to use higher frequencies, and this has resulted in extensive use of the 11-metre band. One problem facing international broadcasters is that they will loose many listeners, particularly in Asia, whose radio receivers do not cover this band.**

Short-wave broadcasters these days are faced with a problem of moving to higher frequencies as dictated by the increased sunspot count. However, they realise that when they make this move they will lose many listeners, as sets in operation in some parts of the world do not cover the 13- and 11-metre bands.

Radio South Africa recently asked its listeners for comments on the use of the 11-metre band, 2790kHz, and found, somewhat to their amazement, that most short-wave listeners now use receivers which cover the higher frequencies. It is only in Asia that it is found that receivers of a more modest type do not receive the higher frequencies.

With the present World Administrative Radio Conference due to commence in September the higher frequencies now being used and the general congestion of all short-wave bands will be one of the major topics. Radio South Africa, in their report, comments that broadcasters seem to be in agreement that there should be more frequencies allocated to broadcasting. One proposal put forward is that the range 13700-14000kHz and 19700-19990kHz should be included in the allocation for broadcasting.

The break-up of the short-wave frequency spectrum at the present time is: 9.5% from 49 to 11-metres has been allocated to broadcasting, 48.9% to fixed point to point services, 28.4% to various mobile services, and 4% to radio amateurs. The largest allocation, 48.9%, is thus for fixed services which these days rely mainly on satellites and cable links.

**Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT. Add 8 hours for WAST, 10 hours for EAST and 12 hours for NZT.**

It is thus obvious that re-allocation is long since overdue and it is hoped that the delegates will settle their differences and make the appropriate adjustments.

### NEW BEIRUT FREQUENCY

Radio Lebanon has made a frequency change, from 15440 to 15285kHz for the broadcast in English 0230-0300GMT. This new frequency gives good, clear reception in this area, and the signals are free from the interference which was prevalent on 15440kHz. News and commentary is followed by popular music at 0245GMT, and at 0300GMT the transmission continues in Spanish. The service to North America opens at 0130GMT.

Another frequency used by Beirut, Lebanon is 21610kHz. This frequency is used for broadcasts to Africa. The station opens at 1830GMT with a program in English, is heard at 2000GMT with a program in French, and closes at 2030GMT. The frequency is clear and gives quite good reception here in New Zealand.

This is the first time we have heard Beirut in the 13-metre band.

### OUT-OF-BAND CHANNELS

The use of out-of-band frequencies is increasing as the main international short-wave bands become overcrowded, and force stations to look for frequencies outside the normal broadcasting areas. This has been noted over the past few months, with many stations moving to frequencies which are free from co-channel interference.

Austria has been observed on 15560kHz, with a transmission to the Near East. The broadcasting time is 1600-1900GMT. Vienna is also using another out-of-band channel, 5945kHz, for a broadcast to North America from 2300-0400GMT.

Radio Korea, Seoul is using the out-of-band frequency of 12090kHz for a broadcast at 1400GMT in English. This signal is very strong up to 1430GMT, when the transmission is continued in Russian. The broadcast in Russian suffers severe jamming.

The transmission ends at 1500GMT, when both Radio Korea and the jammer leave the frequency.

Radio Korea's test transmissions to the Middle East have been observed on the frequency of 6480kHz, which replaces 6240kHz. This broadcast, from 1600-1930GMT is all Korean, and provides fair reception.

### LATIN AMERICAN SIGNALS

Signals from Latin America during the winter months are best received on the lower frequency bands, and some interesting stations have been heard. One of these is the new Peruvian station Radio Fanta, which was heard on 4855kHz, closing at 0520GMT. The station used the slogan "Radio Fanta" many times during the broadcast and when closing gave the call sign of OAX5P.

Signals such as this new one from Peru have been heard, at an excellent listening post south-east of Invercargill, NZ, using aerials over 1200 metres long. Another signal heard was Radio Carve on 6155kHz, opening at 0930GMT. This station, located in Uruguay, was first noted by Stephen Greenyer of Invercargill, and suffered interference from the Far East Network in Japan, also on 6155kHz.

### VOICE OF AMERICA

The Voice of America has two transmissions which are designed for listeners in Australia and New Zealand for morning and evening listening. The

# SHORTWAVE SCENE

broadcast for morning reception 2200-2400GMT is carried on two transmitters from Dixon, California, using 21610 and 26095kHz. A further two transmitters at Tinang, Philippines, are using 17740 and 17820kHz for this service.

The evening transmission from 1100GMT is on 5955 and 9730kHz from Dixon, and 11715 and 15425kHz from Tinang. The morning transmission from Monday to Friday includes a 30 minute news program, followed by popular music in each one hour section of the broadcast.

### CANADIAN CHANGES

Radio Canada International at Montreal has three transmissions to North America, and these also provide secondary coverage to the South Pacific. A frequency alteration has recently been made with 9605kHz being replaced by 11940kHz for two of the programs. The first broadcast from 0200-0227GMT is on 5960 and 11940kHz. Four frequencies are used from 0300-0327GMT: 5960, 9535, 11845, and 11940kHz. From 0400-0430GMT, the transmission is on 5960, 9535 and 11845kHz. On Mondays listeners can hear "DX Digest" during the last ten minutes of each transmission.

An alteration has been made to the time of two popular news programs from Radio Canada. "News at 6" and "As it Happens" are now heard from 2100-2300GMT on 15325 and 17875kHz. The address of Radio Canada International is PO Box 6000, Montreal, Quebec, Canada.

### HIGH FREQUENCY SIGNAL

Radio Peking has been noted on 30027kHz at fair signal strength, with the program including Chinese-English lessons at 0535GMT. The broadcast continues with topical Chinese music until closing at 0600GMT. This interesting signal continues to be heard during our winter, and no doubt other stations will make their appearance above the recognised 10-metre amateur band.

### EXPANSION OF RADIO BRAZIL

The recent test transmissions of Radio Bras at Brasilia have now been extended with three English programs each day. And the station has just purchased five further transmitters for an international service.

The broadcast from Brasilia is now in English 2000-2100GMT on 15270kHz beamed to Europe, but suffers some interference from the Voice of America. A frequency change to 15280kHz is made at 2100GMT, when there is a broadcast in English to Africa, but here again there is light VOA interference. The third transmission in English 0200-0300GMT is also carried on 15280kHz, and this transmission has light interference from KGEI in San Francisco. The address of the station is Radio Bras, Radio National, Box 04-0340, Brasilia, 70323, Brazil.

### ENGLISH FROM OSLO

Radio Norway's transmissions to Australia and New Zealand provide good reception. The program on Sundays is of the most interest because of its English half hour. Called "Norway This Week", this is broadcast on the last 30 minutes of the transmission.

The broadcasts to Australia are: 0700-0830GMT on 9590, 15135, and 21655kHz; and 1100-1230GMT on 15345 and 21730kHz. On Monday afternoons two further sessions in English can be heard: 0300-0430GMT on 9645, 11860, and 11895kHz; and 0500-0630GMT on 11860, 15170, and 21655kHz.

### CHILEAN SIGNALS

The Voice of Chile at Santiago has been heard on two new frequencies — 11755kHz and 15240kHz. The transmission on 11755kHz is heard in Herman at 2200GMT, English at 0400GMT and Spanish at 0430GMT. The frequency of 15240kHz is blocked by Radio Australia.

Two signals of local stations in Chile have also been noted. One of these is Radio Mineria on 9750kHz, which opens at 1010GMT with full station announcement. The other good signal is from Radio Cooperativa Vitalicia which opens at 1100GMT on 6150kHz.

The frequency of 6150kHz is also used by the ABC Melbourne, and the Chilean signal can be heard through this transmission. At 1130GMT a program called Radio Nacional de Chile is broadcast, which is a network news summary.

### TAIWAN TO CONTINUE

The American Forces Taiwan Network, which actually closed in April, is on the air again under new management. In the past, the station has operated on medium and shortwave, and it is expected that in due course a full transmission schedule will be resumed.

In a letter to the Taiwan Government, the Commander of the United States Taiwan Defense Command had formally agreed to transfer AFNT's equipment to the government as a gift. A corporate body would be formed to manage the new station, with the American Chamber of Commerce in Taiwan taking charge of day-to-day operations. The National Policy Adviser to the President of Taiwan will be appointed Chairman of the station's Board of Directors.

☆ SPECIALS ☆

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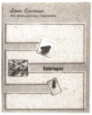

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| 747 | .90 | 7493 | .40 |
| 3909 | 1.05 | 7495 | .75 |
| 7400 | .18 | 74154 | 1.20 |
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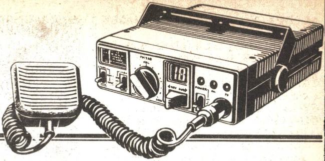
# The Australian CB SCENE



## HOLLAND TO INTRODUCE CB RADIO — ON 27MHz FM!

**According to recent reports, Holland is poised to introduce a form of CB radio on 27MHz FM. If they do this, and if their lead is followed by other European nations, it will tend to further entrench the use of the frequency for CB style communications worldwide. It is a significant move on the eve of WARC '79.**

**by NEVILLE WILLIAMS**

Two or three years ago, the position in Holland roughly paralleled that in Australia. CB radio was illegal but a large number of Asian-sourced 27MHz transceivers were in regular use, having been brought into the country across the German border, and by other routes.

The Australian Government conceded the position here, and legalised CB along American lines. They probably had little choice because Australian regulations (like those of Britain) make it necessary to prove that equipment is being used illegally before a prosecution can succeed.

The Dutch Government, on the other hand, responded by enacting special legislation which made it an offence even to possess CB equipment! It had a rather more salutary effect.

In the face of this tough stand, it has come as surprise to find that the same Government is now clearing the way for a service which will be CB style, if not in name.

What is more, the new service will not be on UHF, as might have been expected. UHF would automatically have limited range and aligned with a growing body of opinion in England, just across the Channel. It might also have taken advantage of Philips expertise in this part of the spectrum. However, other factors seem to have taken precedence.

Prominent among these is the fact that the 27MHz region is already widely used throughout Europe for low-priority citizen level communication, much as in the days of the so-called "Industrial band" in Australia. The frequency is even subject to European (CEPT) recommendations covering its use for the purpose.

For the most part, the equipment involved is of low power, often hand held with integral antenna, confined to AM and/or FM and subject to the same kind of limitations as applied in Australia in the pre-CB era. As such, the facility has been little publicised and is in a completely different ball park from the American/Canadian/Japanese/Australian formula of AM-SSB, 5W-12W power, separate antennas, and so on.

In the last-named countries, CB radio has been seen as a derivative from normal commercial 2-way radio. CB transceivers have been nominally down-rated and mass-produced for a quantity market but, in practice, they bristle with modern technology and are very much performance-orientated. They breed an expectation of powerful signals and long range contacts, little different from the expectations of the amateur fraternity.

Having observed the attendant chaos which has resulted, both in the spectrum and the marketplace, the Europeans are keen not to see a re-enactment of it in their own crowded continent.

Apparently, the present mood in continental Europe is to continue to live with 27MHz and the existing CEPT recommendations, but relying on low power, integral antennas, simple modulation (no SSB) and other restrictions to limit range and congestion.

One observer put it to me this way: "In Europe, they are tending to regard personal 2-way radio as an upward extension of the electronic toy trade, rather than a downward extension of professional telecommunications. The approach discourages the expectation — and usually the reality — of anything but local contacts.

"While the equipment will have to meet strict design requirements, it will remain essentially unpretentious, and therefore less open to the now-familiar abuses of existing high performance CB equipment."

It was against this background that a departmental report before the Dutch Government recommended that they authorise a service on 27MHz, providing for 22 channels in line with the CEPT recommendations, a maximum ERP of 0.5W and with frequency modulation only.

The enabling legislation, which was reportedly passed in late January, is identified in Holland as MARC (licensing general radio communication). As elsewhere in Europe, the term "citizens band" is not popular with the authorities. It envisages that licences will be granted to individuals 16 years of age and older, who have passed an examination — presumably to do with procedures and regulations. Unlawful or obscene transmissions are strictly forbidden, as also is the transmission of music or advertising matter.

An interesting sidelight to all this is that Philips and Mullard (in Holland and England respectively) have developed two special ICs which would form the basis of a low power 27MHz FM transceiver. They might make possible an approach — and specifications — which could rule out, not only the whole spectrum of existing CB transceivers but others which might be contrived outside Holland to tap the new market. What is more, it seems entirely possible that other countries in Europe may see fit to fall into line with Holland. Reportedly, Belgium is currently re-examining its existing 27MHz "business" radio.

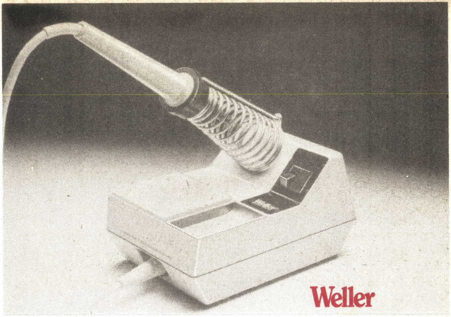
According to information published recently by "Wireless World", useage of 27MHz for low priority communication is quite widespread, but there is considerable diversity in the detail, the name and the role of these citizen-level services:

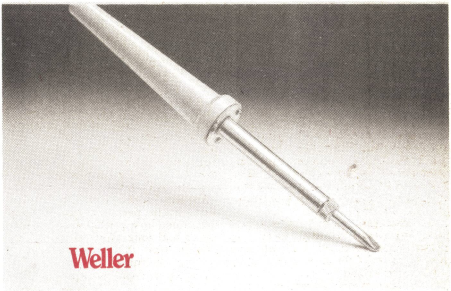
AUSTRALIA: 22 channels 4W erp AM, 12W pep SSB. (Also 40 channels 5W FM on 470MHz).

AUSTRIA: 12 channels, 0.5W erp, AM & FM.
BELGIUM: 0.1W erp business, not CB.
BRAZIL: CB type service "Public General Radio".
CANADA: 40 channels, AM & SSB, similar to USA.
CYPRUS: Operation by permit.
DENMARK: Available to all citizens, but 12-15 years under supervision. 22 channels plus maritime, small type-approved transceivers, AM and FM only, no SSB.
FINLAND: 22 channels plus marine, 5W, AM only.
FRANCE: 22 channels 100mW max., portable only. For 5mW or under, no licence required. (Between 26.96 and 27.28MHz).
GREECE: Legal CB service.
IRELAND: CB activity evident, possibly unsupervised.
ISRAEL: Community service for kibbutzim.
ITALY: 22 channels 1W erp, hand-held with integral antenna.
MONACO: Similar to France.
NEW ZEALAND: 14 channels (26MHz) AM only.
NORWAY: 26 channels total, 5W AM. 10 channels to private radio, others allocated to sports, industry, public services, etc.
POLAND: Permits available to clubs if need is demonstrated.
PORTUGAL: Legal CB service.
S. AFRICA: 19 channels of CEPT band, AM, 100mW; 22 channels of 27MHz, 5W AM, 20W SSB; also on 29MHz, 5W AM, 20W SSB, mainly for mobile.
SPAIN: Legal CB service.
SWEDEN: 11 channels, 0.5W, AM only. 11 channels 5W.
SWITZERLAND: 12 channels, 100mW erp, hand-held only, FM, AM or SSB. Called General Radio. International contacts forbidden.
USA: 40 channels, 4W erp AM, 12W pep SSB. (Also duplex service on UHF).
WEST GERMANY: 12 channels, AM & FM, 0.5W.
YUGOSLAVIA: Permitted on an individual basis.

## TECHNICAL GLOSSARY

DETECTOR: a word with a very wide range of possible meanings. In the context of radio receivers and transceivers it normally refers to the particular stage or section of the circuit which "detects" and isolates the modulation associated with the RF carrier. The detector suppresses the RF and passes the audio or information component (the modulation) to the low frequency amplifier, whence it passes to the headphones, loudspeaker, recorder or whatever! In modern receivers, the detector is most commonly a semiconductor diode.





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### ICOM Gear

| | |
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| IC701 | HF solid-state 160 m 10 m transceiver – $1380.00 |
| IC701PS | Matching power supply/speaker for above – $253.00 |
| IC22S | 2 m fm synthesised transceiver – $299.00 |
| IC280 | 2 m fm remotable cpu controlled – $450.00 |
| IC215 | 2 m fm portable inc 1 channel – $229.00 |
| IC402 | 70 cm ssb portable, 3 watts – $439.00 |
| IC502 | 6 m ssb portable, 3 watts – $239.00 |
| IC202S | 2 m ssb portable, 3 watts – $349.00 |
| IC211 | 2 m all-mode ac/dc transceiver $799.00 |
| ICRM3 | Remote control unit – $159.00 |
| ICSM2 | Condenser-electret desk mic. – $45.00 |

### Speech Compressors & Processors (Daiwa)

| | |
|---|---|
| RF660 | Phasing type, dc, 6dB gain – $109.00 |
| RF440 | Phasing type, ac/dc, 6dB gain $126.00 |
| RF550 | Filter type, ac/dc, 6dB gain – $169.00 |
| MC330 | Speech compressor – $99.00 |

### Microphones

| | |
|---|---|
| VM-1 | Noise cancelling hand ptt, dynamic, low Z $10.00 |

### Antenna Couplers

| | |
|---|---|
| CL67A | Daiwa 1.9 – 28 MHz 500 W pep – $135.00 |
| CNW217 | Daiwa incl. SWR/PWR meter, 200 W – $165.00 |
| CNW417 | Daiwa incl. SWR/PWR meter, 500 W – $199.00 |
| MFJ901 | MFJ. Matches everything 1.8 – 30 MHz – $119.00 |
| MFJ16010 | MFJ. Random wire tuner 160 - 10 M $71.00 |
| MFJ941 | 160 - 10 M, 300 W, incl. SWR/PWR – $157.00 |
| LAC-895 | Leader 3.5 thru 28 MHz – $169.00 |

### Antenna Rotators (Daiwa)

| | |
|---|---|
| DR7600S | Heavy Duty with controller & mast clamps – $259.00 |
| DR7500S | Medium Duty with controller & mast clamps – $189.00 |
| 6 Core | Cable for above (200 m rolls) – $1.00/m |

### QRP Transmitter (MFJ)

| | |
|---|---|
| MFJ40T | 5w. 40 meter CW (Xtals not included) – $59.00 |
| MFJ40V | UFO unit for above – $59.00 |

### Hand Held Transceiver

| | |
|---|---|
| AR240 | 2 meter 800 ch. synthesized, i. 5 w. – $365.00 |

### Daiwa Low Pass Filters

| | |
|---|---|
| FD30LS | 32 MHz, Fc, 200 w., 3 stages – $20.00 |

### Baluns

| | |
|---|---|
| AS-BL | Asahi 50 ohm for beams – $34.00 |
| BL50A | 50 ohm, 4 KW, 1:1 for dipoles – $30.00 |
| BL70A | 70 ohm, 4 KW, 1:1 for dipoles – $30.00 |

### Leader Test Equipment

| | |
|---|---|
| LAC-895 | Antenna Coupler 3.5 – 28 MHz – $169.00 |
| LPM-885 | SWR/PWR Meter – $89.00 |
| LPM-880 | RF Power Meter – $135.00 |
| LDM-815 | TR Dip Meter – $89.00 |
| LBO-310 | 3" Ham Oscilloscope – $310.00 |
| LA-31 | Ham monitorscope adapter – $25.00 |

# Just arrived!

## The IC22s 2m FM transceiver

The most popular FM rig around. It's now available at a special price. Come in and check it out.

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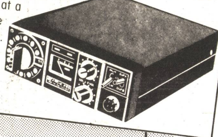

### Radio Teletype Terminal

| | |
|---|---|
| 0-7000 | Tono RTTY CW/Baudot/ASCii – $699.00 |

### Tubes

| | |
|---|---|
| 6KD6 | Finals for Yaesu linears – $9.00 |
| 6JS6C | Finals for Yaesu transceiver – $9.00 |
| 12BY7A | Driver – $3.75 |
| 6146B | Finals – $12.00 |

### CW Filters

| | |
|---|---|
| FT101E | Yaesu – $39.00 |
| TS520S | YG3395 Kenwood – $57.00 |
| TS820S | YG88C Kenwood – $59.00 |

### Morse Keys

| | |
|---|---|
| HK702 | Deluxe Key with marble base – $41.00 |
| HK708 | Economy key – $23.00 |
| HK706 | Operator's Key – $25.00 |
| MK701 | Manipulator (side-swiper) – $45.00 |
| PALOMAR | 1C Keyer – $149.00 |

### SWR/PWR Meters & Dummy Loads

| | |
|---|---|
| VC-2 | Twin meters 3-150 MHz with cal. chart – $35.00 |
| SWR200 | Oskerblock 3-200 MHz, 2/20/200/2000 W – $86.00 |
| SW210A | Daiwa 1.8 thru 150 MHz, 20/120 W, direct – $99.00 |
| SW410A | Daiwa 140-500 MHz, direct reading – $129.00 |
| CN620 | Daiwa Cross-needle, 18-150 MHz, direct – $99.00 |
| CN630 | Daiwa 140-450 MHz, 20/200 W, direct read. – $135.00 |
| CN650 | Daiwa 1.2 – 2.5 GHz, 2/20 W, direct read. – $169.00 |
| LPM-885 | Leader SWR/PWR meter – $89.00 |
| LPM-880 | RF Power Meter – $135.00 |
| RW-155D | Kuranishi RF Power Meter – $185.00 |
| RW-151D | Kuranishi RF Power Meter – $165.00 |
| RW-1002L | Kuranishi RF watt meter – $139.00 |

### Coaxial Change-Over Relays (Daiwa)

| | |
|---|---|
| CX-2L | 1.8 thru 170 MHz, 100 W pep max – $45.00 |
| CX-2H | 1.8 thru 450 MHz, 200 W pep max – $69.00 |

## Kenwood Transceivers

| | |
|---|---|
| TS520 S | HF Transceiver $635.00 |
| TS120 V | Solid state HF transceiver $530.00 |
| TS120 S | HF transceiver, 100 W P.O.A. |
| SM220 | Station Monitor P.O.A. |
| TS180 S | HF transceiver – P.O.A. |

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### Coaxial Switches

| | |
|---|---|
| CS201 | 2 position, high pwr, to 500 MHz – $23.00 |
| CS401 | 4 position, high pwr, to 500 MHz – $59.00 |

### Jaybeam Antennas

| | |
|---|---|
| 5Y/2m | 5el 2 m, 7.8 dBd gain, length 1.6 m – $43.00 |
| 8Y/2m | 8el 2 m, 9.5 dBd gain, length 2.8 m – $51.00 |
| 10Y/2m | 10el 2 m, 11.4 dBd gain, length 4.4 m – $84.00 |
| 10XY/2m | 10el 2 m, cross yagi, 11.3 dBd – $114.00 |
| D8/70cm | Twin 8el, 70 cm, 12.3 dBd, 1.1 m – $64.00 |
| PBM 18/70 | 18el, 70 cm, 14.9 dBd, 2.8 m – $96.00 |
| MBM 48/70 | 48el, 70 cm, 15.7 dBd, 1.83 m – $83.00 |
| MBM 88/70 | 88el, 70 cm, 18.5 dBd, 3.98 m – $105.00 |
| PMH/2C | Phasing harness – $20.00 |
| 8XY/2m | 2 m cross yagi, 8el, 9.5 dBd, 2.8 m – $99.00 |
| 12XY/70 cm | 70 cm cross yagi, 12el, 13.0 dBd, 2.6 m – $139.00 |

### Parabolic Dishes

| | |
|---|---|
| PBA-1200 | 70 cm and 1.2 GHz complete – $349.00 |

### Rak Antennas

| | |
|---|---|
| AL24DXN | 20 - 40 m trap dipole – $70.00 |
| A4VPN | 40 m dipole kit – $27.00 |
| LISTENER 3 | Short wave Rx antenna – $49.00 |
| LISTENER 1 | Short wave Rx antenna – $22.00 |

### Nagara

| | |
|---|---|
| SS56 | 6 m 5el beam 1 KW – $159.00 |
| V5JR | 80 - 10 m trap vertical, 6.7 m high – $129.00 |
| V4JR | 40 - 10 m trap vertical, 5.2 m high – $99.00 |

### Hy-Gain Antennas

| | |
|---|---|
| HYQUAD | 10/15/20 m, 2 element quad – $279.00 |
| 204BA | 4 el monobander for 20 m – $259.00 |
| TH6DXX | 6 el tribander – $310.00 |
| TH3MK3 | 10/15/20 m 3 el beam – $249.00 |
| TH3JR | 10/15/20 m 3 el beam – $229.00 |
| 203BA | 3 el beam 20 m – $199.00 |
| LONG JOHN | 5 el wide-spaced 27/28 MHz – $180.00 |

### Scalar

| | |
|---|---|
| M22T | 1/4 wave 2 m mobile whip, top only Qty 1 - 4 – $7.00 |
| M25T | 5/8 wave 2 m mobile whip, top only Qty 1 - 4 – $14.00 |
| BASE | B/L for above – $4.00 |

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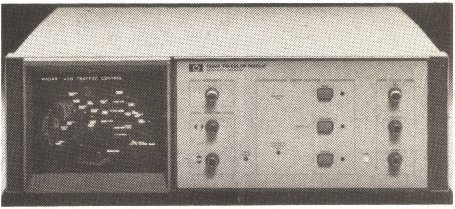
# New Products

## 3-colour vector graphics display from H-P



A new three-colour CRT display unit from Hewlett-Packard helps solve the problem of reading high speed, high density information displays. Called the Model 1338A Tricolour Display, the unit is a high resolution, high speed electrostatic display. It is useful in any application where data must be interpreted rapidly, such as in air traffic control and process control. Because data can be colour coded to identify different results, the display is useful in instrumentation, flight simulation and computer-aided design systems.

Red, green and yellow colour hues are generated by varying the CRT post accelerator voltage, which changes the energy with which the electron beam strikes the phosphor. The technique offers higher resolution than raster scan systems, since a shadow mask is not required, allowing placement of red, green or yellow colour dots anywhere on the screen.

The beam penetration phosphor technique also allows fast colour switching. This is provided in the 1338A by a high-speed post accelerator voltage colour switch, which initiates a change in as little as 100 microseconds for colour switching of up to 600 blocks of data per second.

The 1338A is a 178mm diagonal stand alone X, Y, Z display. X, Y and Z inputs are analog while colour switching is TTL. The display is designed to interface with the H-P 1350A Graphics Translator for a colour graphics system with access to the Hewlett-Packard Interface Bus (HP-IB, HP's implementation of IEEE-488-1975). TTL level colour switching, colour busy, and colour valid signals allow control of the colour of each vector or character. Colour control is via a remote control connector in the digital input configuration.

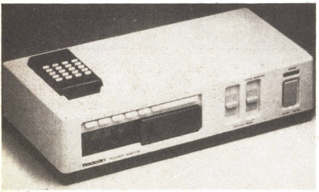
The 1338A features a high quality HP electrostatic deflection system for fast settling time, low power consumption and reliability. X and Y bandwidth is greater than 3MHz and the Z-axis rise time is less than 30 nano-seconds.

For further information contact Hewlett Packard Australia Pty Ltd, 31-41 Joseph Street, Blackburn, Victoria 3130. Telephone 89 6351. Branches in Adelaide (272 5911), Brisbane (229 1544), Canberra (80 4244), Perth (386 5455), and Sydney (449 6566). Also in Auckland and Wellington, NewZealand.

## "Compucruise" now available in Aust.

The Compucruise on-board automobile computer described in the news columns of our May issue (page 4) is now available in Australia. The local agents are Performance Monitors, PO Box E384, Canberra, ACT 2600, who advise that the price is $220 with cruise control, or $185 without. The unit can be fitted to any type of vehicle except those using fuel injection.

## Add-on Teletext decoder works with any TV set



A new add-on Teletext decoder which mates with any standard colour or monochrome TV receiver has been announced by GFS Electronic Imports. Known as the TAD-100, the unit connects between the antenna lead and the set's antenna input terminals; it requires no modification of the set whatever.

The unit features a remote command keyboard for selection of the required teletext page. It also provides remote VHF channel selection, having a built-in 4-channel preset VHF tuner with AFC. Remodulation is performed by a true PAL encoder and VHF AM balanced modulator.

Further information on the TAD-100 is available from GFS Electronic Imports, 15 McKeon Road, Mitcham, Victoria 3132.

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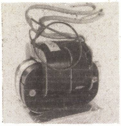

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| MODEL JT248, 10V, 10A | **$22.95** |
| MODEL JT249 0-15V<br>8.5-0-8 5V 4A<br>FOR MICRO PROCESSOR | **$23.95** |
| MODEL JT274 10V 10A<br>2 x 12V 1A | **$22.95** |
| MODEL JT 253A<br>0-18V 30A PEAK | **$41.95** |

P.P. MODEL 253A NSW **$3.50** V.Q.T. **$5.50** SA WA NT **$7.00**
P.P. ALL OTHER MODELS NSW **$2.95** V.Q.T. **$3.75** WA SA NT **$5.50**

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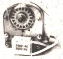

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5RPM. Plenty of torque. With Cam and N/O N/C microswitch. 15 switch contacts per min. OA size. 65 x 60 x 35mm.

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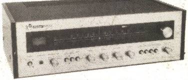
**AM-FM STEREO RECEIVER/AMPLIFIER**

**WAY BELOW LIST PRICE**



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**$147.00** PP NSW $2.75, VQ $3.75, T SA $4.75, WA NT $6.00.

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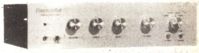

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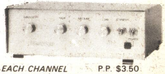

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XJ3 dome tweeter available 8 and 15 ohms. Other models 8 ohms only.

## Clamp type power meters

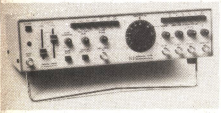
Available from H. Rowe & Co, the Hioki Models 3131 and 3133 power testers are for single phase and 3-phase work respectively.

Both models feature a clamp-on power sensor, making it possible to take readings without power line interruption. Model 3131 features 3 voltage ranges from 100V to 500V, 5 current ranges from 10A to 250A, and 5 power ranges from 5kW to 100kW. A companion model, Model 3132, measures up to 1000A and 500kW.

Model 3133 is somewhat more elaborate. It has a 3½-digit LED readout and measures voltage to 500V in 2 ranges, current to 200A in 2 ranges, power to 200kW, and reactive power to 200kvar. It, too, has a companion model (Model 3134), and this measures current to 1000A, power to 1000kW, and reactive power to 1000kvar.

Enquiries to H. Rowe & Co Pty Ltd, 127 Newbridge Road, Moorebank, NSW 2170.

## Function generator

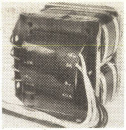


Krohn-Hite's Model 1400 Sweep Function Generator combines a 0.2Hz to 3MHz main generator with a 0.001Hz to 1kHz ramp generator. The instrument has 14 different operating modes, including up or down sweeping and independent start/stop slide controls.

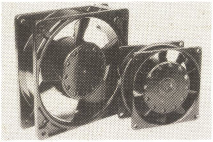
The main output provides sine, square, triangle, ramp and pulse waveforms. The amplitude is adjustable from 5mV to 20V p-p, with a calibrated attenuator and vernier. The DC offset is variable from -10V to +10V.

Further information from Warburton Franki Pty Ltd, 374 Eastern Valley Way, Chatswood, NSW 2067.

## 20A transformer, cooling fans

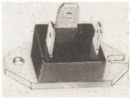


Stewart Electronics has released a new range of power transformers designed for microcomputer system power supplies. The transformers use a double C-core, and have an electrostatic shield. Model SE805 has an 8V/5A and two 14V/1A secondaries; model SE810 offers 8V/10A and two 15V/1A, while model SE820 offers 8V/20A, 15V/1A and 15V/3A. Prices range from $16.00 to $29.50.



Also available are two sizes of compact equipment cooling fans, made by the West German firm EBM. These are of sturdy all-metal construction and have sleeve bearings. The larger size is very similar to the popular "Muffin" type, while the smaller is very similar to the "Sprite". Both are $24.50 from Stewart Electronics, 33 Sunhill Road, Mount Waverley, Victoria 3149.

## Teccor triacs in new "Fastpack" package



Rifa, Australian distributor for the Teccor range of SCRs and triacs, has announced details of a series of Teccor triacs in the new Fastpack package.

The new Fastpack triac features the industry preferred wide spacing of quick-connect terminals for fast, strong no-solder connections with either individual terminals or a polarised connector.

The Fastpack's electrically isolated TO-3 flange is copper plated to dissipate heat faster and more efficiently than other packages. The open slot provides quick orientation in assembly. The device is rated at 25A up to 600V, and is epoxy encapsulated for maximum ruggedness. In addition, glass passivation provides a stable blocking life.

All Fastpack triacs will withstand a minimum high potential test of 1600V AC from terminals to mounting surface for one minute at 80°C case temperature.

For further information contact: Rifa Pty Ltd, 202 Bell Street, Preston, Victoria 3072.

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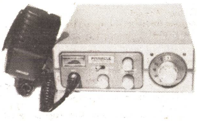

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# Books & Literature

## 8080 & analog

**THE BUGBOOK VII: MICROCOMPUTER — ANALOG CONVERTER SOFTWARE AND HARDWARE INTERFACING with experiments for 8080A/Z80/8085 systems, by Jonathan Titus etal. Published by E & L Instruments Inc, Derby, Connecticut, 1978. Soft covers, 153 x 228mm, 21mm thick; many diagrams.**

Another of the E & L Instruments "Bugbook" series books, written by Jonathan Titus, Christopher Titus, David Larsen and Peter Rony. As the title explains this one deals with microcomputer DAC and ADC interfacing, with particular emphasis on the 8080 series of processors. as with the other books in the series, it is basically intended as a laboratory guide for college students, but can also be used by the private reader.

The book is divided into seven "units", with titles as follows: 1 — Interfacing Digital-to-Analog Converters; 2 — Interfacing Analog-to-Digital Converters; 3 — Dual-Slope ADC's and Digital Panel Meters; 4 — miscellaneous Conversion Techniques; 5 — Sample and Hold Circuits and Multiplexer Devices; 6 — Bits, Boards and Black Boxes; 7 — Experiments with DACs and ADCs. Two data appendices end up the treatment.

It is assumed that the reader is familiar with 8080 assembly language programming (in octal). Also no attempt is made to describe DAC or ADC circuits in detail, as with other books in the Bugbook series, the emphasis is on using commercially available modules as building blocks.

The text is clear and concise, and very readable; it is also well served by illustrations. in short I think it is likely to be found of considerable value by anyone seeking an introduction to this subject.

The review copy came from Stewart Electronics, of 33 Sunhill Road, Mount Waverley, Victoria 3149. (J.R.)

## TTL circuits

**50 CIRCUITS USING 7400 SERIES ICs, by R. N. Soar. Bernard Babani (Publishing) Ltd, London 1979. (BP58). Soft covers, 108 x 180 mm, 76pp, many diagrams. Price in UK £1.35.**

A recent addition to the Babani "50 Circuits using . . ." series, this deals with 7400 series TTL digital ICs. It is basically written for the hobbyist experimenter, although it could also be of value to others as a source of ideas.

The author begins with a breif introduction to TTL devices and logic gates. He then launches into the fifty circuits, each of which is accompanied by a few paragraphs of explanatory text.

Many of the circuits are just basic logic configurations — such as how to produce a positive-logic AND, OR and NOR function using the positive logic NAND elements in a basic 7400 device. Others are merely the same circuit used for different tasks. But included in the book as well are a number of useful practical circuits — not generally for complete gadgets, but rather for functional blocks. Blocks like crystal oscillators, phase detectors, RF switches, switch debouncers and so on.

A handy little book for the experimenter, although the text is alittle rough in places.

**RADIO HANDBOOK**

by William I. Orr **$26.50**

**BRAND NEW EDITION (21st)**

Howard W. Sams & Co Inc introduces a completely updated 21st edition of the famous communications handbook that is the electronics industry standard for engineers, technicians, and advanced amateurs. The book explains in authoritative detail how to design and build all types of radio communications equipment. It contains a greatly enlarged section on semiconductor and IC circuit design. Included are ssb design and equipment;rtty circuits; expanded section on linear amplifiers, both solid state and tube types; vhf and uhf transmitters and converters; special purpose and logic circuitry, as well as information on new narrow band voice modulation (NBVM); plus a chapter on electronics mathematics. 1136 pages; 6½ x 9½; hardbound (ISBN: 0-672-24034-3) c 1978 (A Editors and Engineers publication).

*Postage $1.20 Vic, $1.75 other States.*

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The review copy came direct from the publisher in Britain. (J.R.)

## Simple projects

**PROJECTS IN RADIO AND ELECTRONICS, by Ian R. Sinclair. Newnes-Butterworth, London, 1979. Soft covers, 135 x 216mm, 92pp, many diagrams. Recommended retail price $6.00.**

Another book in the Newnes "Constructors Projects" series, aimed at the newcomer to practical electronics. In this case it describes some fourteen simple projects in the radio and test equipment area, all of them using readily available and low cost parts.

The book begins with a brief introduction to components and the practicalities of project construction, including an explanation of the way copper-strip board is used in all of the projects to be described. Then follow the chapters describing the projects, titled as follows:

1 — Transistor Tester; 2 — Signal Booster; 3 — RF/AF Signal Injector; 4 — Single Transistor Receiver; 5 — Simple IC Receiver; 6 — Signal Strength Meter for Short Waves; 7 — Electronic Ohmmeter; 8 — High Resistance Voltmeter; 9 — Dip Oscillator; 10 — SW Converter; 9 — Dip Oscillater; 10 — SW Converter for Transistor Radios; 11 — AC Millivoltmeter; 12 — Bench Power Supply; 13 — Bench Amplifier; 14 — Pulse Generator.

## Handy reference

**PRACTICAL ELECTRONIC CALCULATIONS AND FORMULAE, by F.A. Wilson. BP53. Bernard Babani (Publishing) Ltd, London, 1979. Soft covers, 111 x 181mm, 248pp, many diagrams and tables. Price in UK £2.25.**

Another recent release by Babani, this time a very handy little reference book. It covers all of the basic electronic design formulas and calculations, and presents them in a highly practical manner. The emphasis is on putting them to work, and wherever possible tables and graphical methods are used to replace tedious calculations.

The areas covered are indicated fairly well by the chapter headings: 1 — Units and Constants; 2 — Direct Current Circuits; 3 — Passive Components; 4 — Alternating Current Circuits; 5 — Networks and Theorems; 6 — Measurements.

Although superficially the book may seem to be directed towards the hobbyist and experimenter, the material covered and thorough presentation would seem to me to make it just as suitable for the working circuit designer as a handy reference. It should also be of value to college and university students.

The review copy came direct from the publisher in Britain. (J.R.)

# BOOKS

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| Master Handbook of Ham Radio Circuits (Tab Books) | $11.75 |
| The Amateur Radio Vertical Antenna Handbook (Lee) | $7.90 |
| Integrated Circuit Pocket Book (R. G. Hibberd) | $9.50 |
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| VHF Handbook for Radio Amateurs (Herbert S. Brier & William I. Orr) | $9.40 |
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| The Radio Amateur Antenna Handbook (William I. Orr & Stuart D. Cowan) | $11.30 |
| COS/MOS Integrated Circuits Manual (RCA) | $7.95 |

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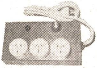

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# INFORMATION CENTRE

**MINI-BRUTE:** I have recently completed assembly of your Mini-Bute power supply described in November 1977 (File No 2/PS/43) and have come across some disconcerting problems. The first is that the output is 13.6 volts with the three 5600uF capacitors in parallel for ripple filtering. Without the three capacitors, the output becomes 5.6 volts — still insuitable for my requirements.

My second problem is that my 6800 system needs a line to ground. The obvious answer would be to carry it from the chassis earth but if the power supply should break down this will more than likely destroy the micro. If I were to put a diode in on this line, which should I choose for sufficient protection and would it be enough? (B. K., Winston Hills, NSW).

● First of all let us state that without the three filter capacitors the power supply will not work at all — it can only produce unfiltered rectified AC. It is likely that the regulator IC is being swamped by leakage from Tr2 and Tr3. This is normally prevented by the 100 ohm resistor connected between the bases of Tr2 and Tr3 and the output. This is shown on the circuit diagram but unfortunately was omitted from the wiring diagram. Did you leave it out too?

There is no reason why the negative line of the power supply cannot be connected to its own chassis, which is connected to the mains earth pin. This should not predjudice the safety of the microcomputer in any way. By the same token, a diode in this chassis connection would in no way protect the computer against a catastrophic breakdown. Our optional overvoltage protection system (published in the same article) will protect against regulator malfunction.

**LONG PERIOD TIMER:** I am one of the older readers of your magazine. I am seeking a project for an electronic clock with an alarm or switch mechanism which can be set up to three days in advance. This would be similar to those used in video tape recorders. Thank you for anything you can do along these lines, and which I feel would also be appreciated by other readers. (A.D., Elsternwick, Vic.)

● Thank you for your comments and suggestions. The idea of a long period timer appears to be a good one, and we will look at the possibility of presenting such a project.

**CAPACITOR DISCHARGE IGNITION:** I have recently built one of your CDI systems (File No 3/TI/12, July 1975). It works exceptionally well on my six-cylinder Holden. My brother-in-law also built one for his Datsun four-cylinder car and it works exceptionally well also. However, my next door neighbour bought two Dick Smith kits, both for V8 cars. In both cases their cars break down at 4000rpm and right through the range of revs, respectively, backfiring and spluttering something terrible.

I have checked his construction thoroughly and could not find any fault in the assembly of his kit. I even went so far as to connect my CDI to his V8 and it broke down terribly and yet it runs my Holden exceptionally well. Tricky one ?? The problem appears to be only with V8 motors. I am hoping you might be able to come up with some suggestions. (G.O., North Mackay, Qld.)

● The problem you have experienced can occur when CDI systems, having fast rise times, are used on larger engines, particularly V8s. The problem is cross-fire, whereby stray capacitance in the spark plug wiring couples the

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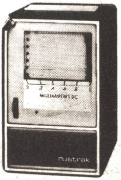

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very fast rise-time pulse from the plug to be fired to other plugs. This means that weak sparks occur in other cylinders at the same time as the main spark occurs in the correct cylinder. The result is an engine which behaves very erratically.

There is no easy solution to the problem, which is probably one of the reasons why major auto-makers, such as Chrysler, employ a transistor-assisted ignition system rather than CDI. The slower rise time and longer duration of the transistor-assisted system spark gives few problems with cross-fire and more reliable ignition of the fuel-air mixture.

If you desire to persist with the CDI system, the solution involves minimising the stray capacitance of the plug leads: keep each spark plug lead as far from its neighbour as possible, using insulated "spreaders" if necessary.

If you are unable to complete an "Electronics Australia" project because you missed out on your regular issue, we can usually provide emergency assistance on the following basis:

PHOTOSTAT COPIES: $2 per project, or $2 per part where a project spreads over multiple issues. Requests can be handled more speedily if projects are positively identified, and if not accompanied by technical queries.

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COMMERCIAL, SURPLUS EQUIPMENT: No information can be supplied.

COMPONENTS: We do not deal in electronic components. Prices, specifications, etc., should be sought from advertisers or agents.

REMITTANCES: Must be negotiable in Australia and made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque endorsed with a suitable limitation.

ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Beaconsfield, 2014.

**ALL-WAVE TWO RECEIVER:** I built the "All-Wave Two" receiver. It works pretty well on AM and CW signals, but on SSB the "monkey chatter" cannot be resolved. I used the reaction capacitor as instructed in the article. The tone of the SSB signal changes with the change of the reaction capacitor, but I can't get the SSB so that it is understandable. Could you give me any advice on what is wrong and how to fix it? (C.J., Phillip Island, Vic.)

● The most likely explanation is that the regenerative circuit is not working correctly and the set is not actually going into oscillation. Your statement that "AM and CW work 'pretty well'" suggests that it is not working as well as it should. The CW signal should be resolved as a distinct note or tone (adjustable), not a series of thumps.

Failure to oscillate could be due to several variables. Try increasing the number of turns on the reaction coil and/or decreasing the distance between this coil and the secondary. (Just a little at a time; don't overdo it.) Try reversing the connections to the reaction coil.

Also try reducing the length of aerial or the coupling to the aerial by inserting a small capacitor in series. With this type of set, adjusting the regeneration to maximum should make it a "RAILWAY SET" — one that whistles at every station!

Until you can do this, it is not working correctly.

## NOTES & ERRATA

**HIGH PERFORMANCE MODEL TRAIN CONTROLLER:** (October 1978, File No. 2/MC/16): Resistor R15, shown as 820 ohms, should be changed to 180 ohms. The 820 ohm resistor shown in error will not permit reliable relay operation.

**CMOS DIE** (April 1979, File No. 3/EG/11): The pin numbers of the 4017 IC were incorrectly shown. Pin 1, shown at top left, should be at bottom right, and pin 16, shown top right, should be at bottom left. There is also an error in the board pattern. Pin 2 of the 4017 is shown connected to pin 3 of 4001B, but should connect to pin 2 of this IC.

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## QUARTZ . . . from page 63

just how far into the RF region the harmonics of the Frequency Reference could be detected and used. An initial check at 30MHz showed that the harmonics of the 10kHz output were very strong and usable. In fact, we even checked at 5kHz and they were still there at good strength.

It is worth noting that the HF receiver which we used in some of these tests used the Wadley Loop principle. Earlier, we used a single conversion full coverage receiver with a 455kHz IF. Due to the poor image rejection at 30MHz, we ended up with twice as many of the 10kHz signals as we should have. This resulted in a hopeless conglomeration. We mention this as a word of warning to any readers who may attempt the same arrangement.

Encouraged so far, we tried the instrument out using a 146 to 148MHz amateur transceiver. Harmonics of 2MHz and 1MHz were quite usable, even without making actual connection to the aerial terminal. By feeding the output through a small trimmer set to about 3pF we were able to make use of harmonics of the 25kHz output! A very useful facility.

Incidentally, it may be noticed that the strength of alternate harmonics will be strong and weak, due to the nature of the harmonic content of the waveform as it reaches the receiver.

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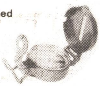

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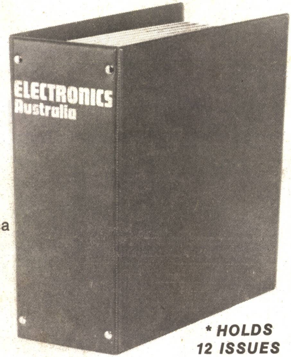

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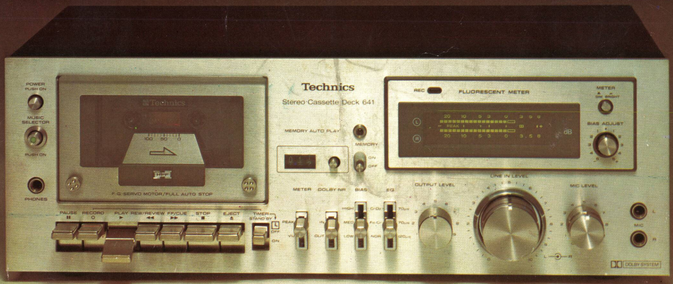

Technics Model RS-641

Technics has gone to great lengths to bring you the RS-641 cassette deck. And it shows.

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The RS-641 employs a vertical hold front-loading system with the cassette compartment boasting an indicator for tape left to run and a back projected light. There's also a music selector switch which allows you to locate the beginning of your favourite track . . . automatically.

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